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(22) Date of Filing 13.09.1990

Date Lodged 23.09.1993

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01237115	14.09.1989	
02221020	24.08.1990	

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(51) INT CL^5
B65H 31/34 37/04

(52) UK CL (Edition M)
B8R RAD10 R501 R511
U1S S2262

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None

(58) Field of Search
UK CL (Edition L) B8R RAD10 RAD5 RAG3 RAG5 RARC RAR1 RAR2 RSC RS7
INT CL^5 B65H 9/10 31/34 31/38

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(72)cont
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Yuji Ueno
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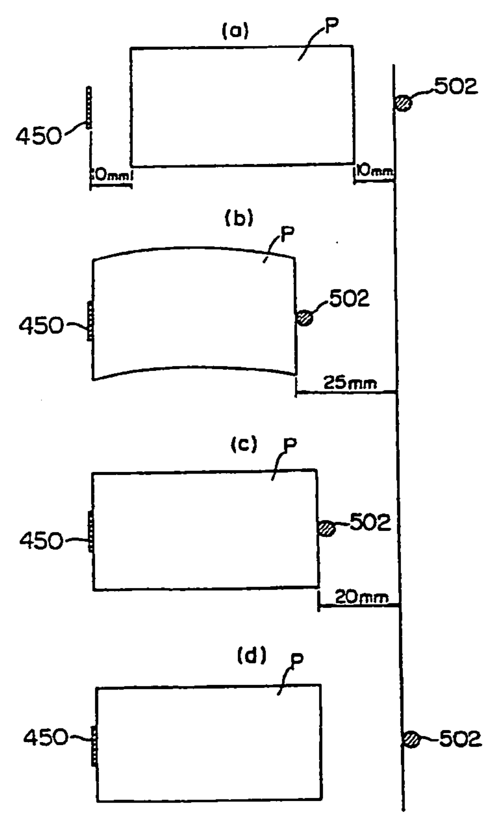
(54) Aligning sheets prior to stapling.

(57) Sheets P fed one-by-one to form a stack on a tray having a side registration fence 450 are aligned by a member 502, which moves from a first position (a) permitting entry of a sheet onto the tray, to a second position (b) bending the sheet against the fence, to a third position (c) in which the spacing between fence 450 and member 502 is equal to sheet width, and then back to the first position (d). The tray may be one of a plurality of superposed trays in a sorter/collator. The stack of aligned sheets may be withdrawn from the tray by a reciprocating gripper and stapled.

FIG. 70



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The date of filing shown above is that provisionally accorded to the application in accordance with the provisions of Section 15(4) of the Patents Act 1977 and is subject to ratification or amendment.

FIG. 1 PRIOR ART

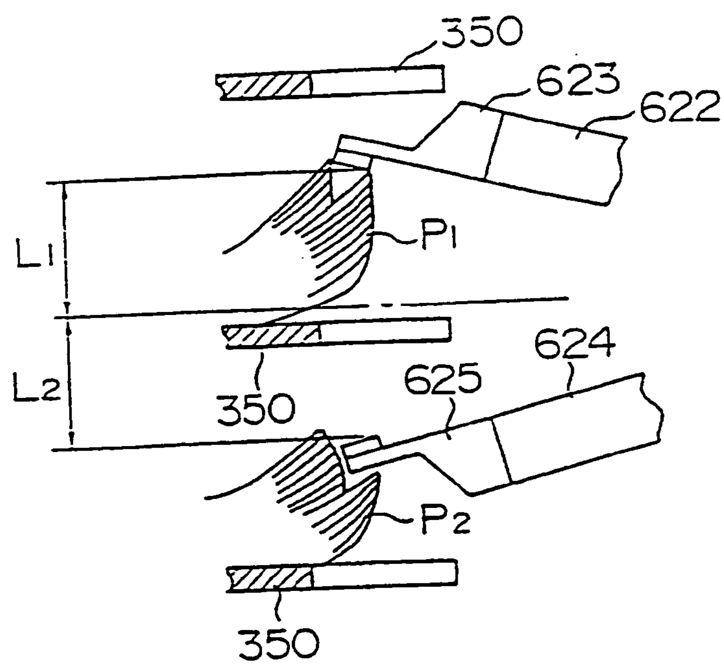

FIG. 2 PRIOR ART

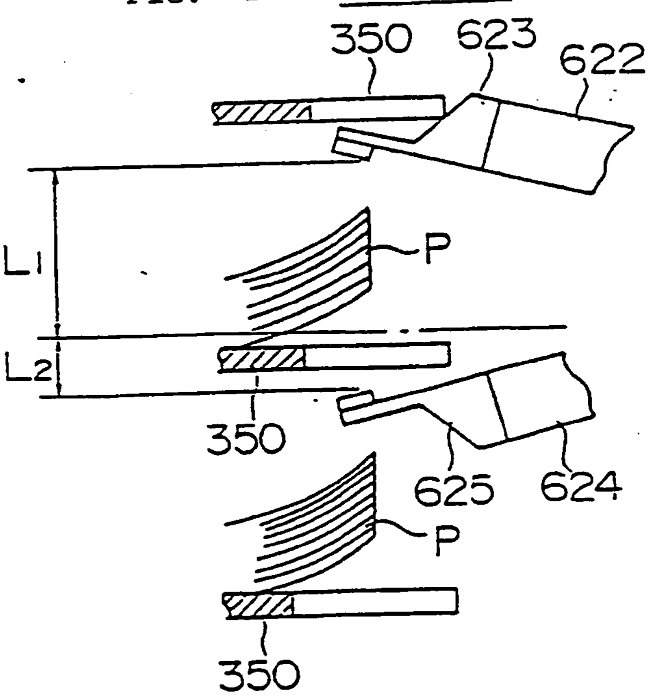

FIG. 3 PRIOR ART

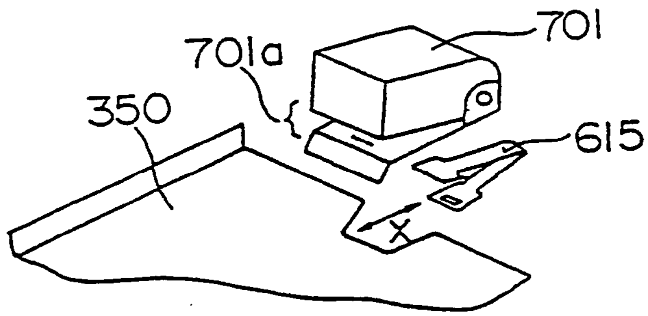

FIG. 4 PRIOR ART

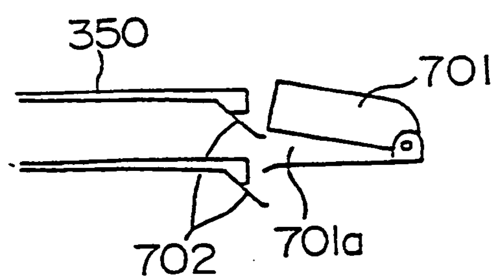

FIG. 5

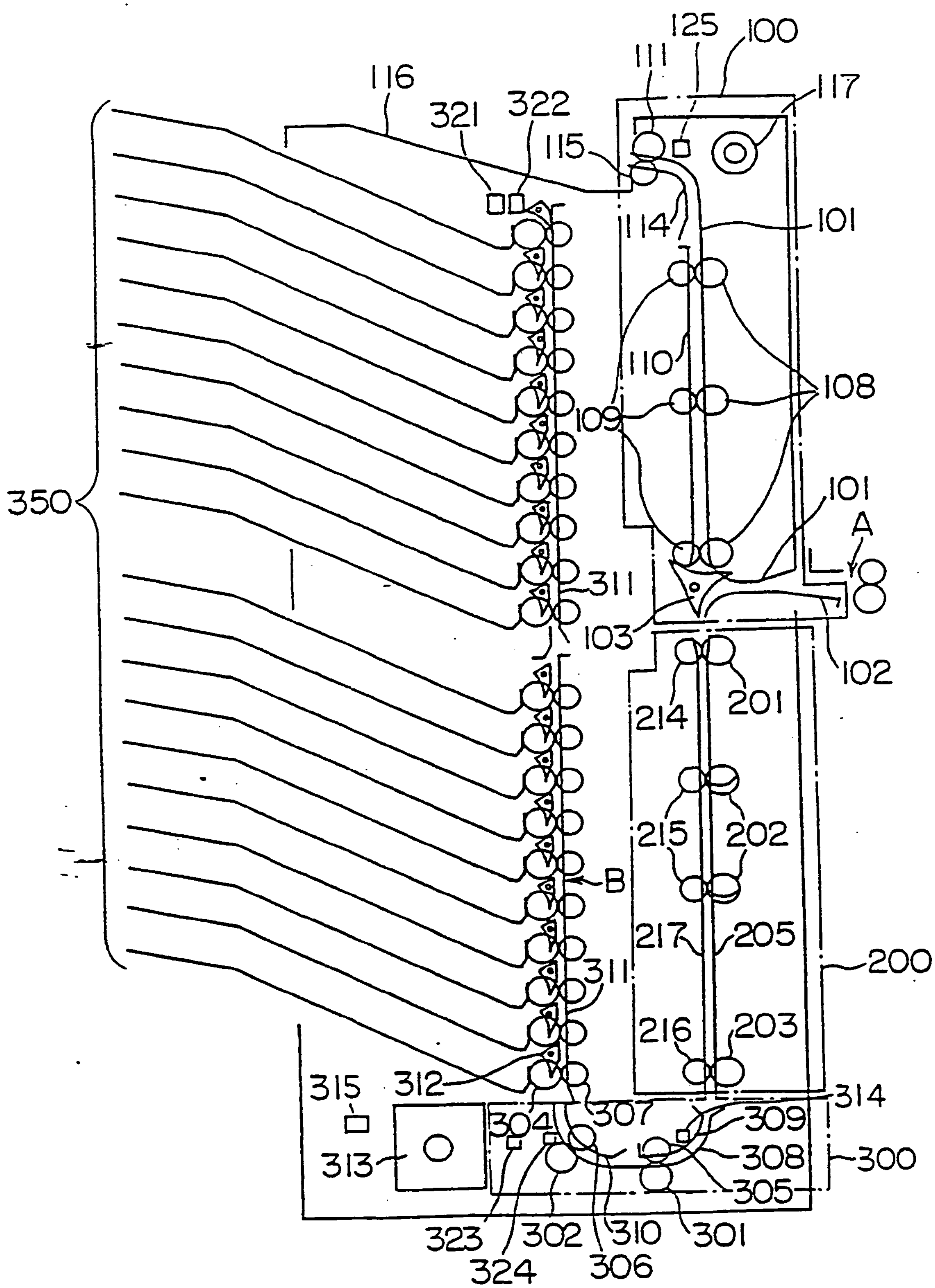

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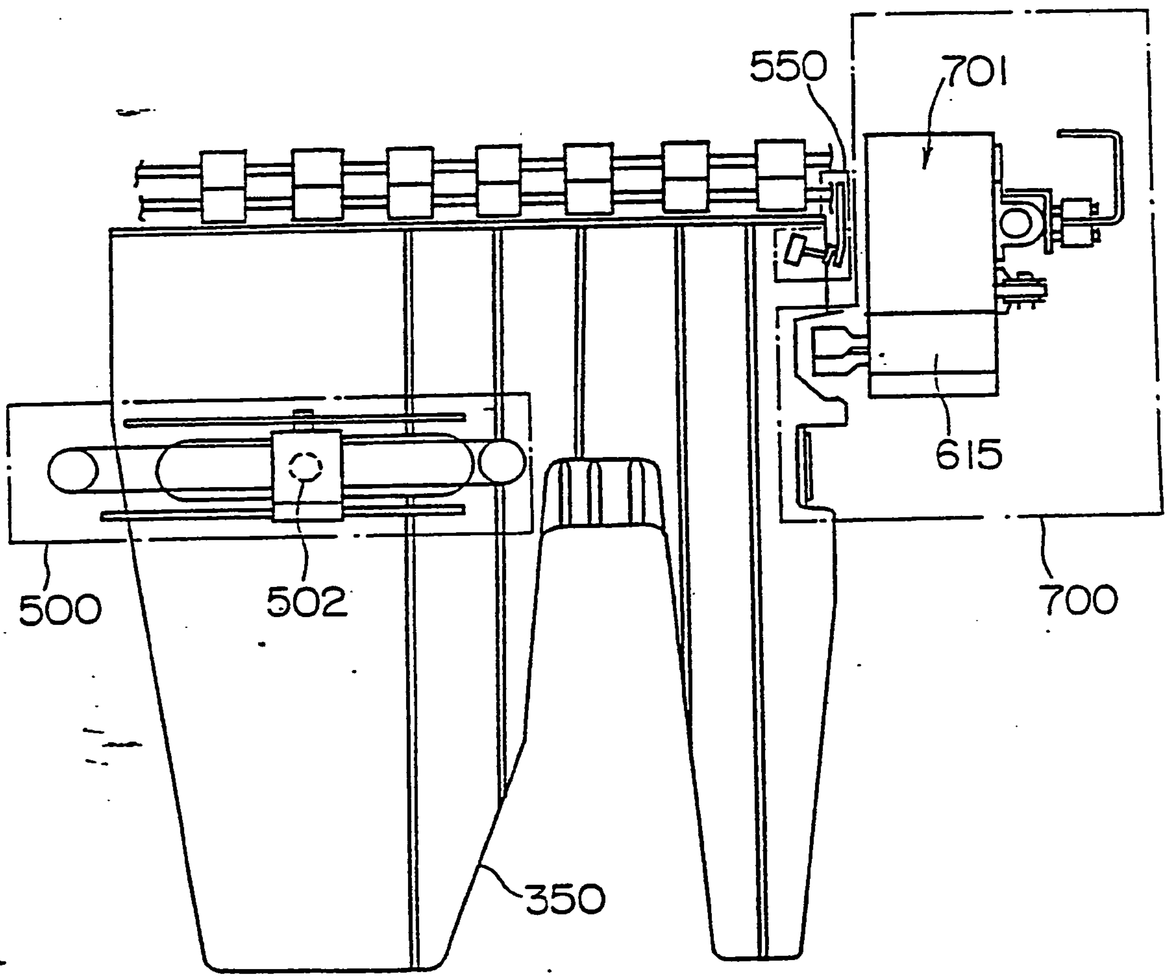
FIG. 6



5/50

FIG. 7

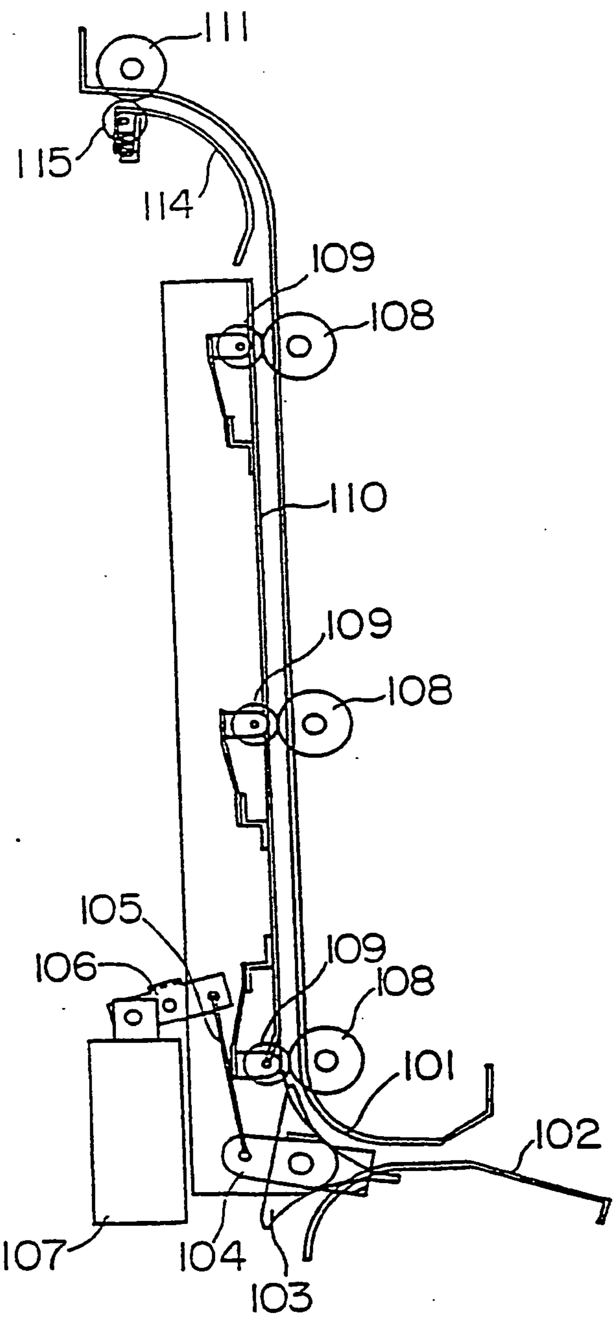


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FIG. 8A

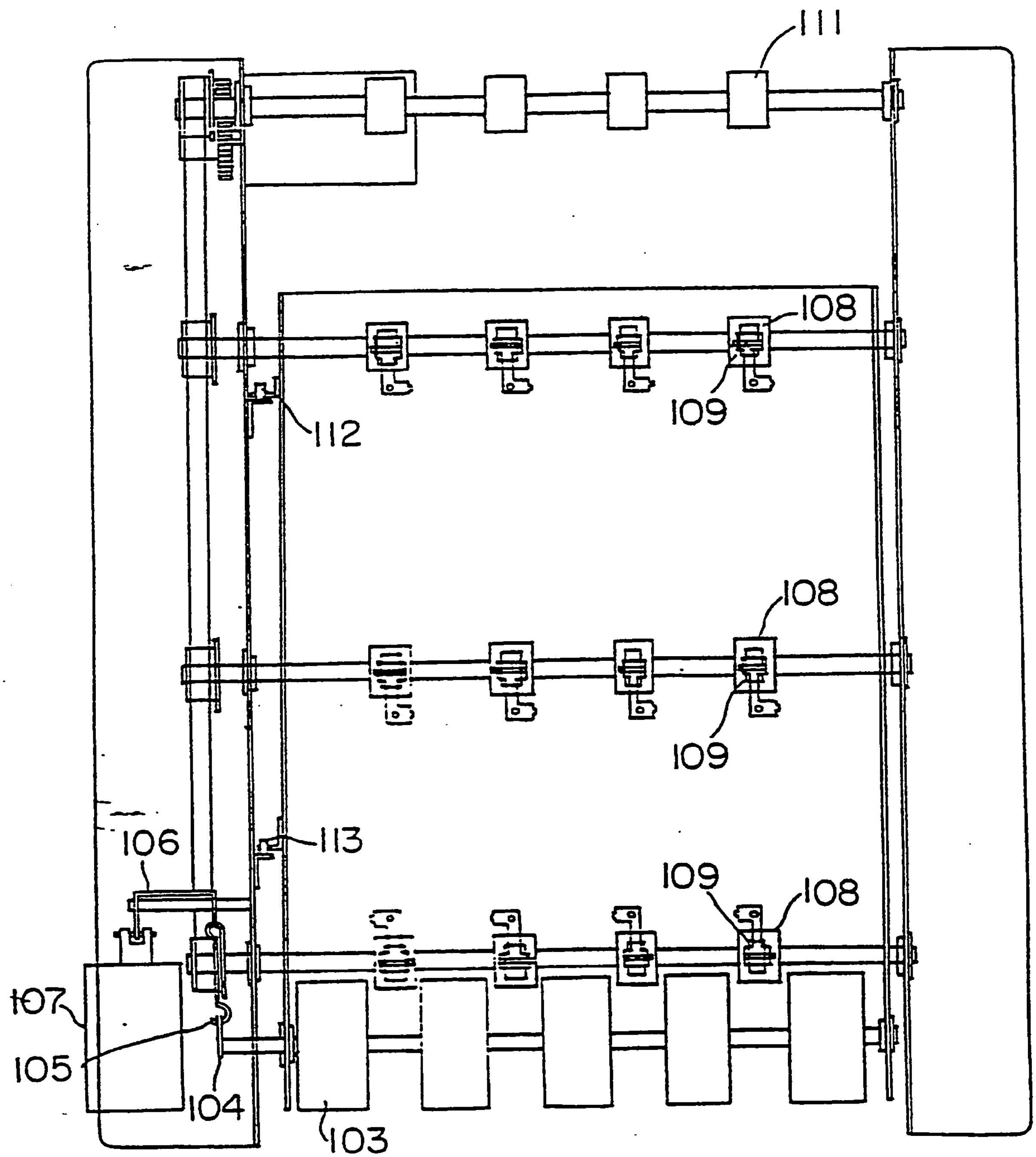

FIG. 8B

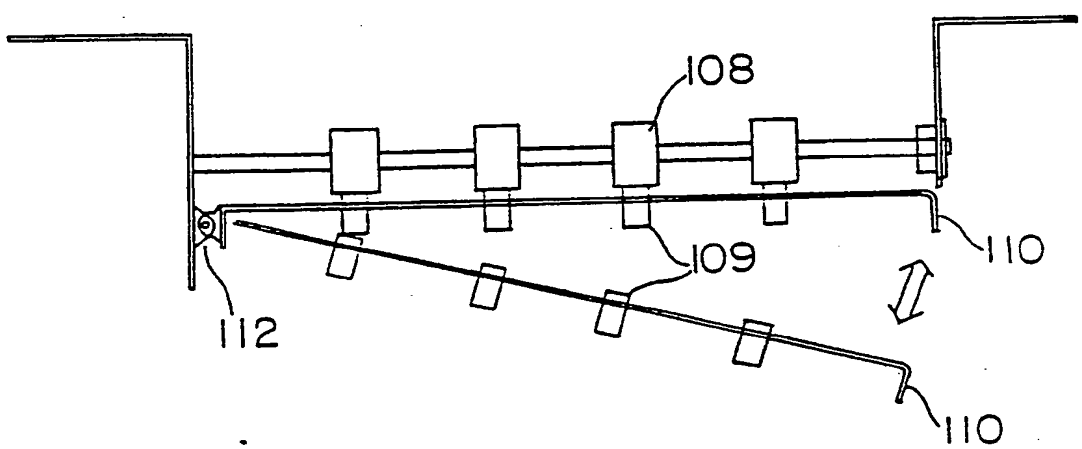

FIG. 9

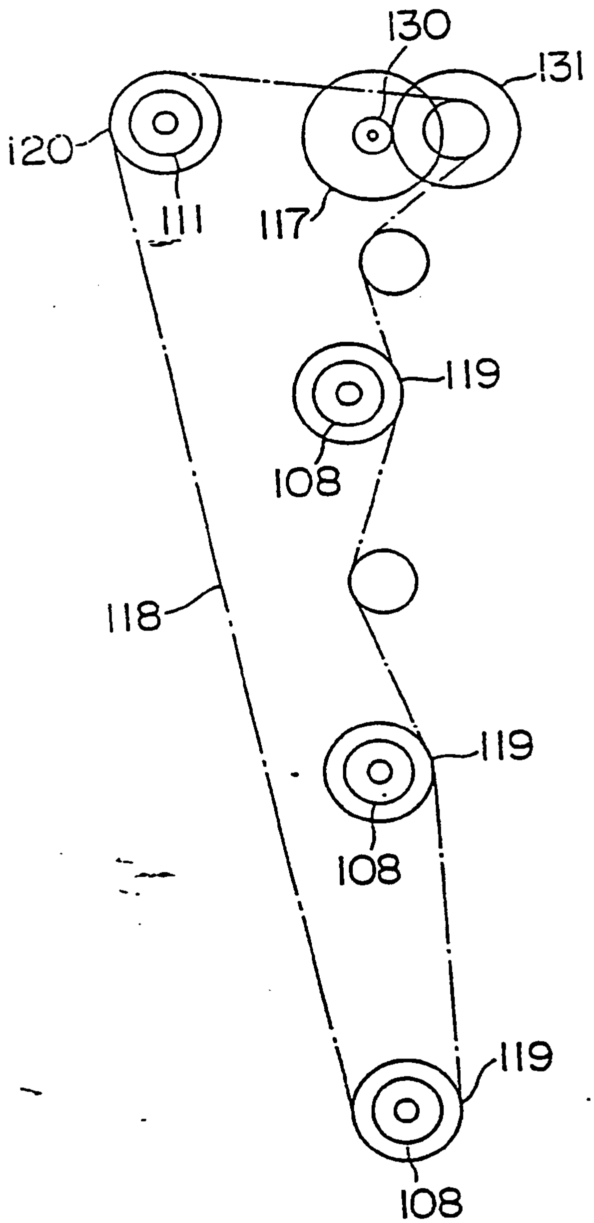
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FIG. 10

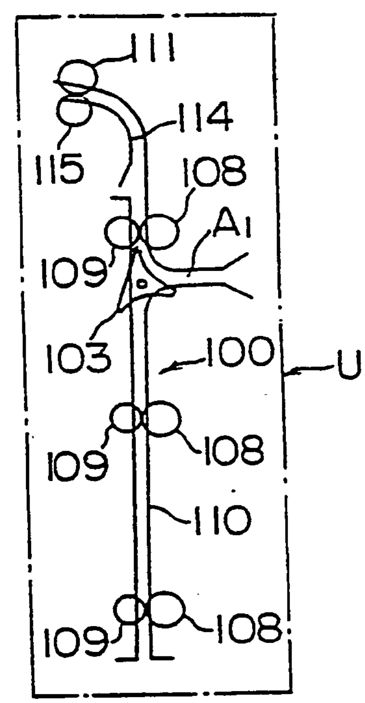
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FIG. 11

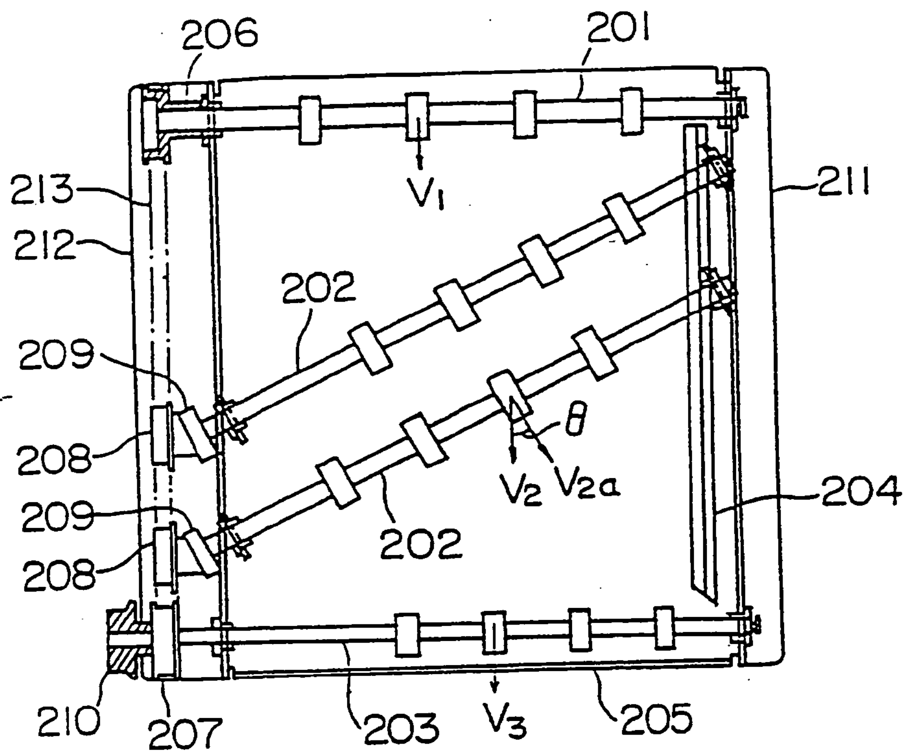


FIG. 13

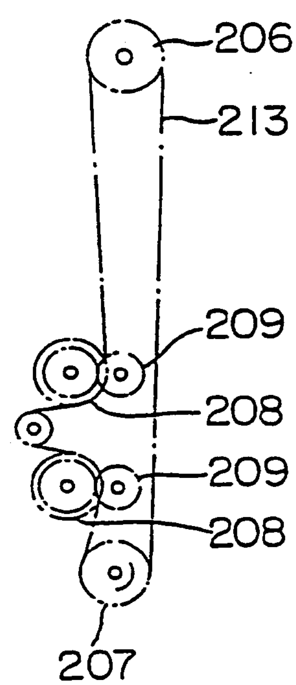


FIG. 12

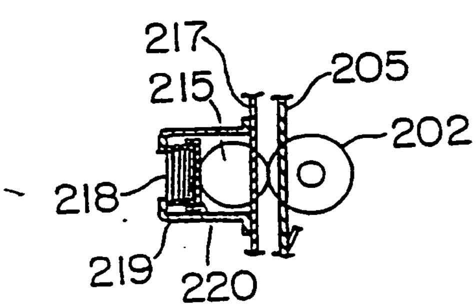


FIG. 14

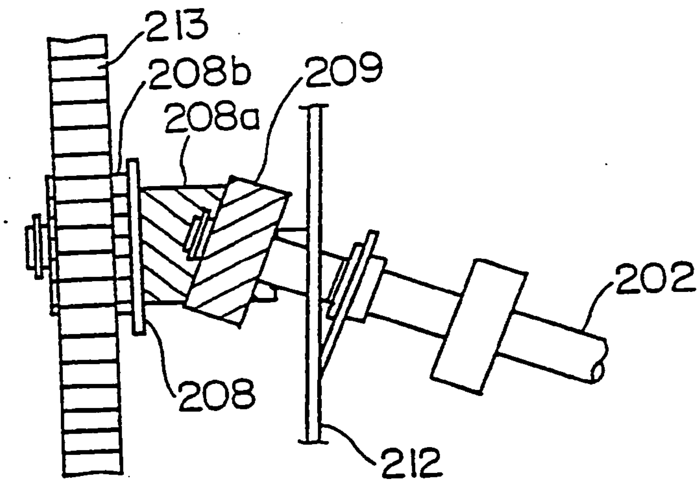


FIG. 15

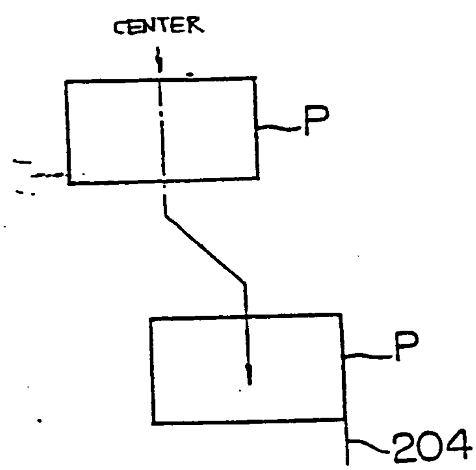


FIG. 16

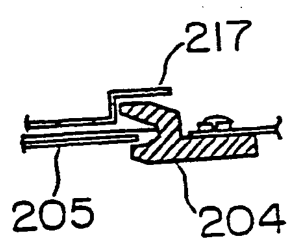
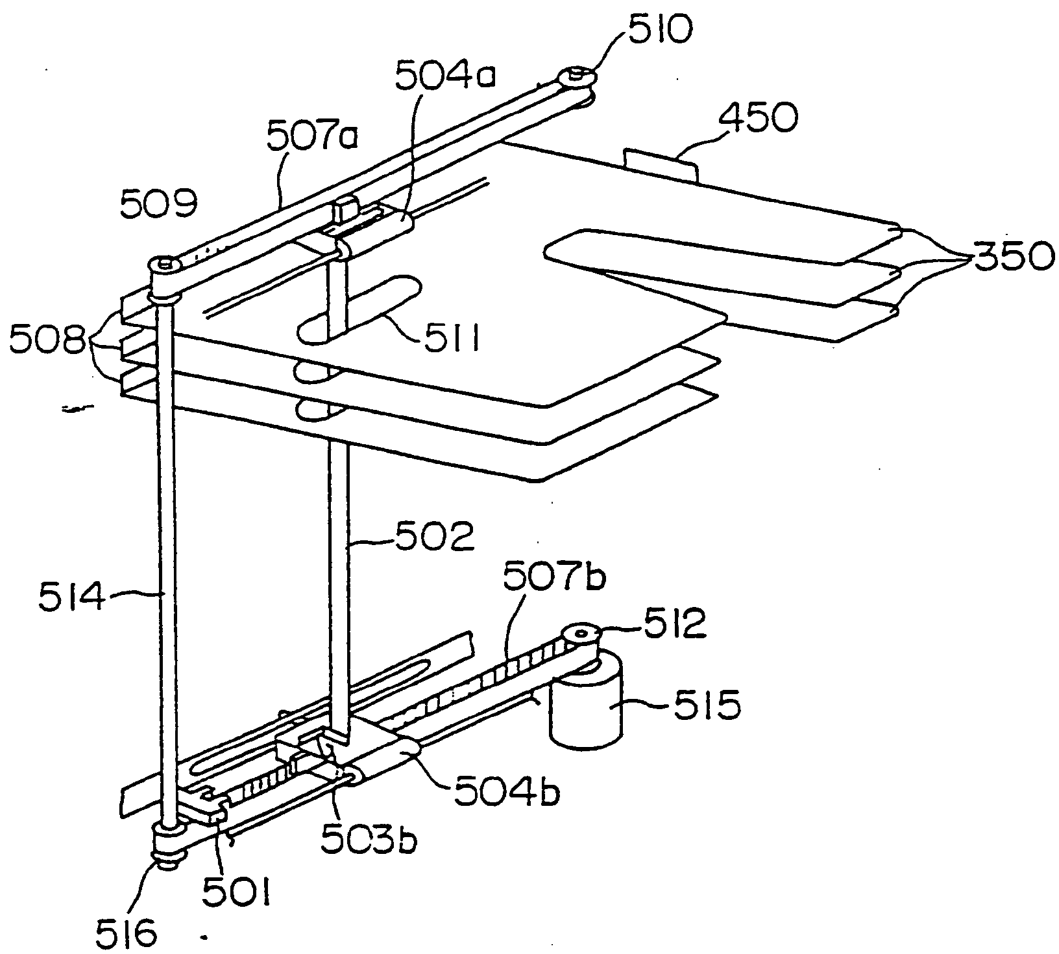


FIG. 17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504a
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507a
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507b
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512
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504b
503b
501
516

FIG. 18

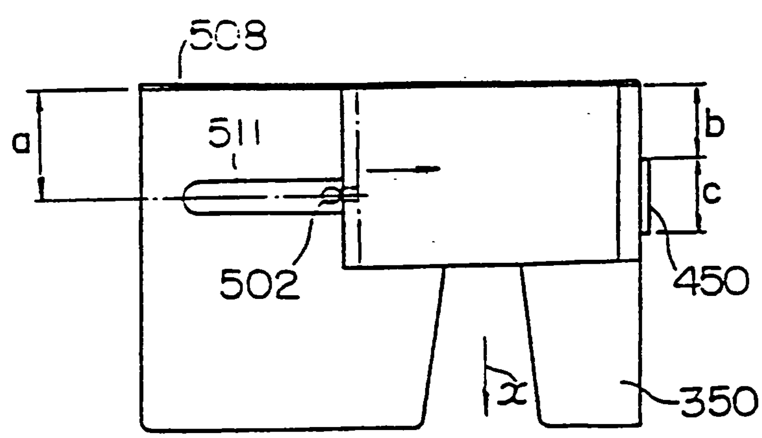

508
a
511
b
c
502
450
x
350

FIG. 19

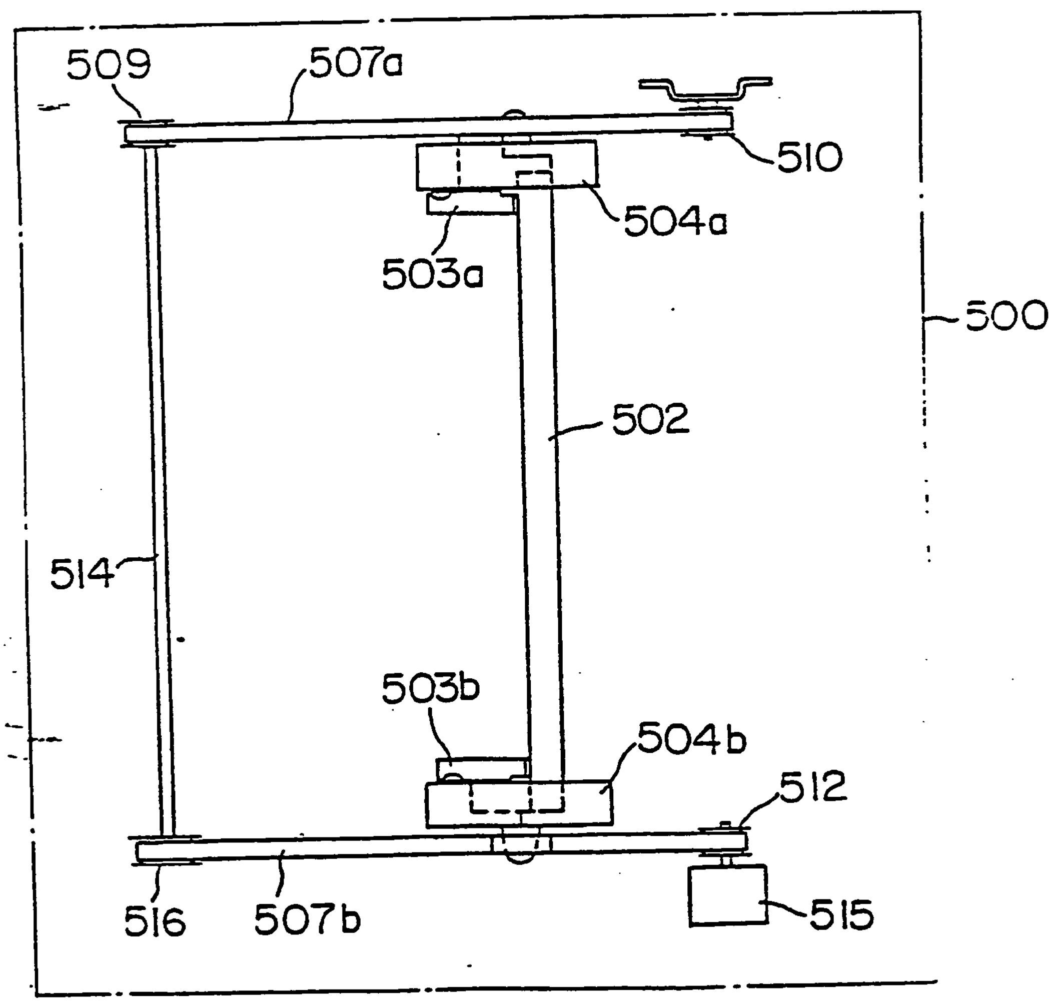


FIG. 20

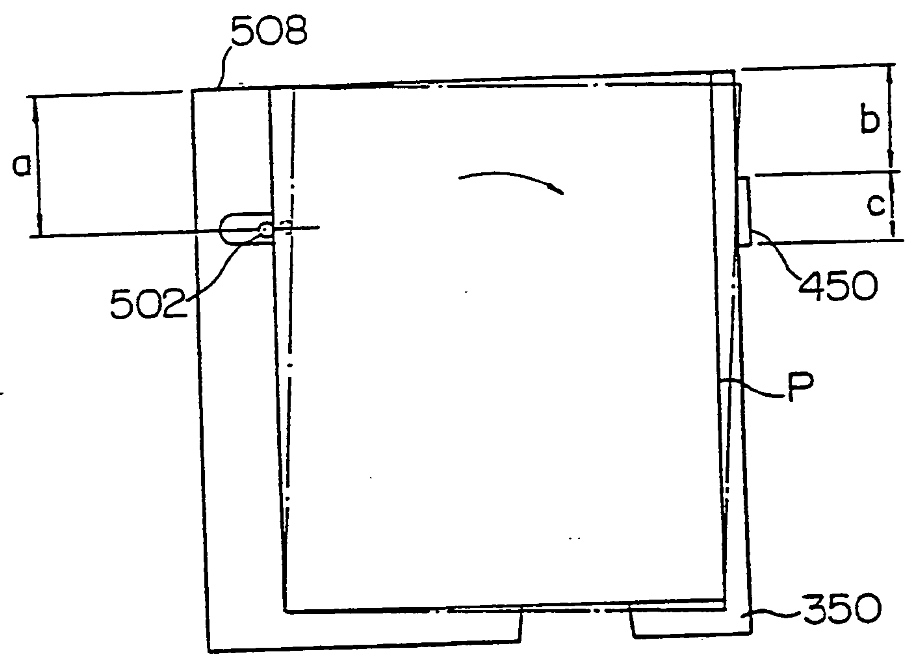


FIG. 21

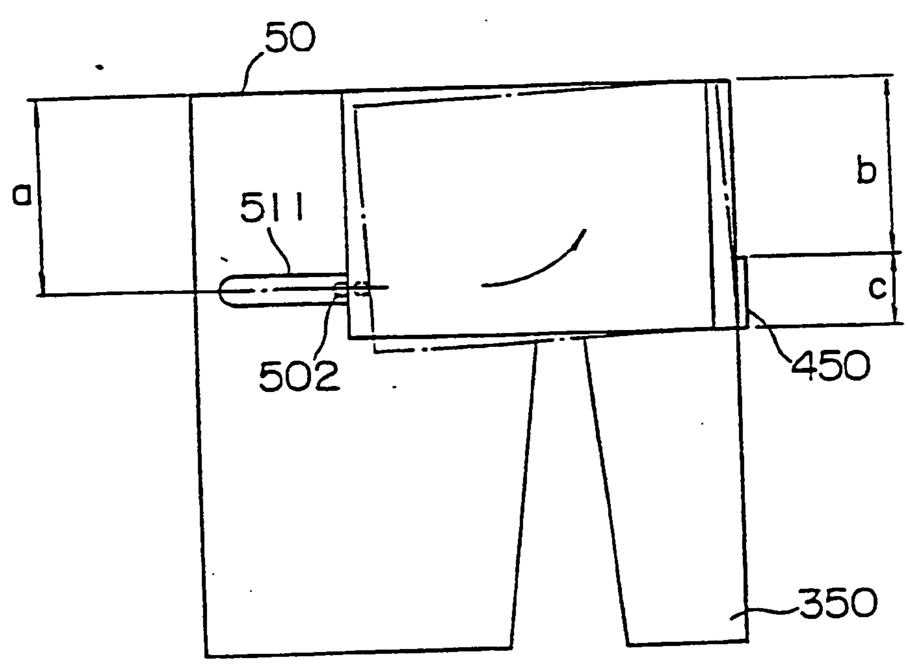


FIG. 22

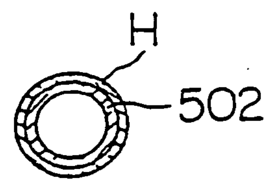


FIG. 23A

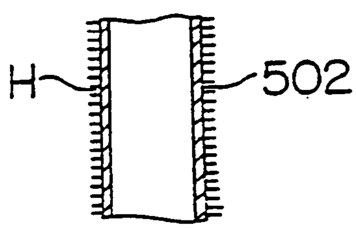


FIG. 23B

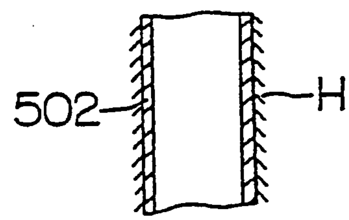


FIG. 24

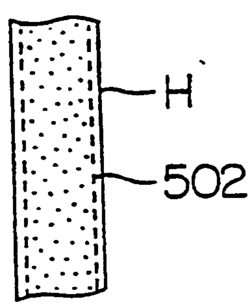


FIG. 25

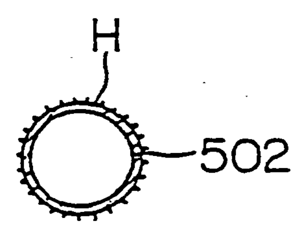


FIG. 26

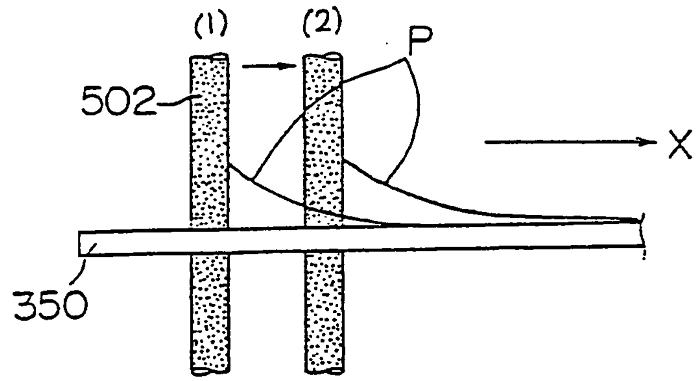


FIG. 27

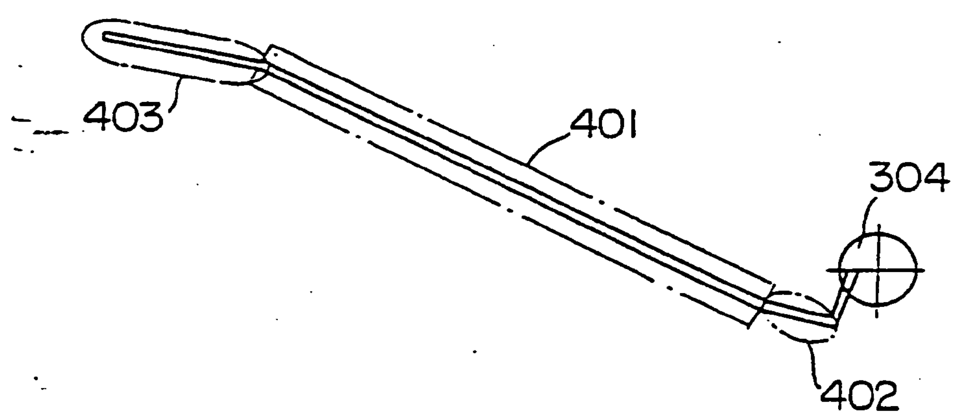


FIG. 28

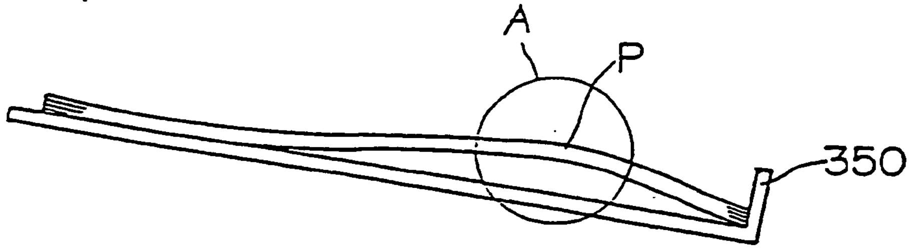


FIG. 29

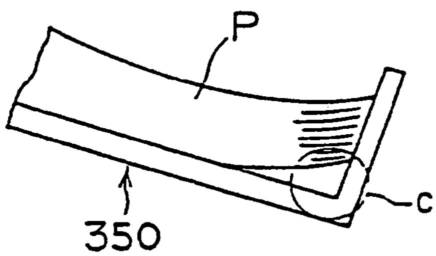


FIG. 30

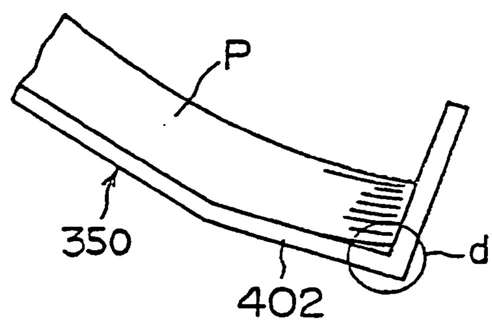


FIG. 31

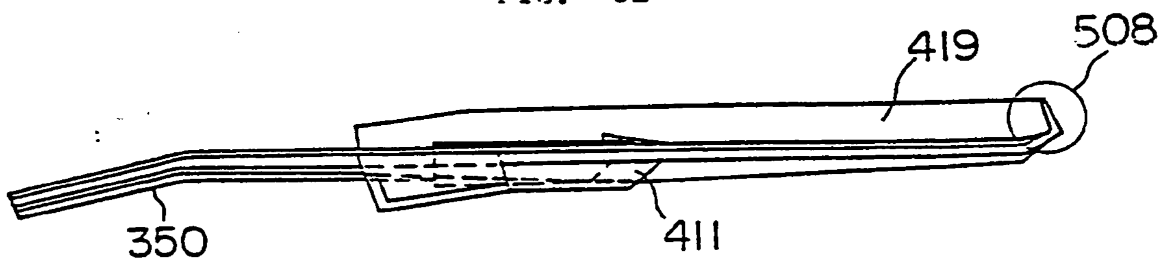
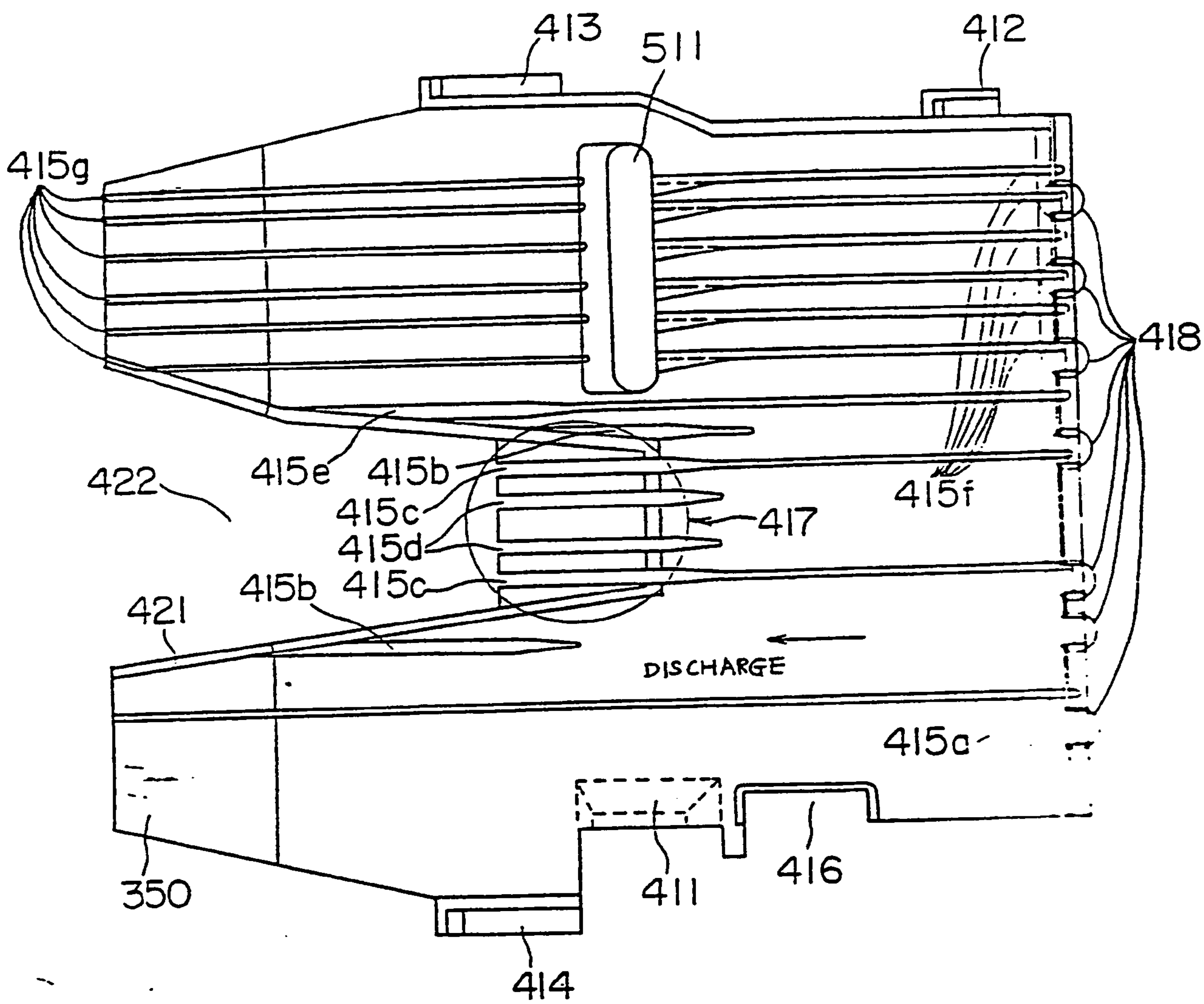


FIG. 32


413
511
412
415g
418
422
415e
415b
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415d
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415f
421
DISCHARGE
415a
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411
416
414

FIG. 33

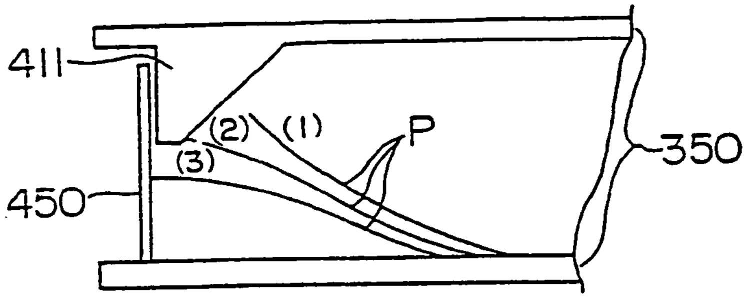

FIG. 34

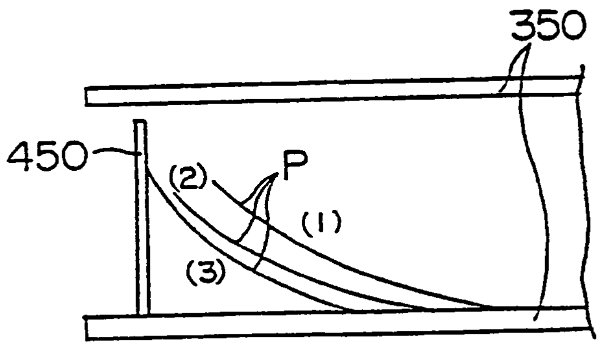

FIG. 35

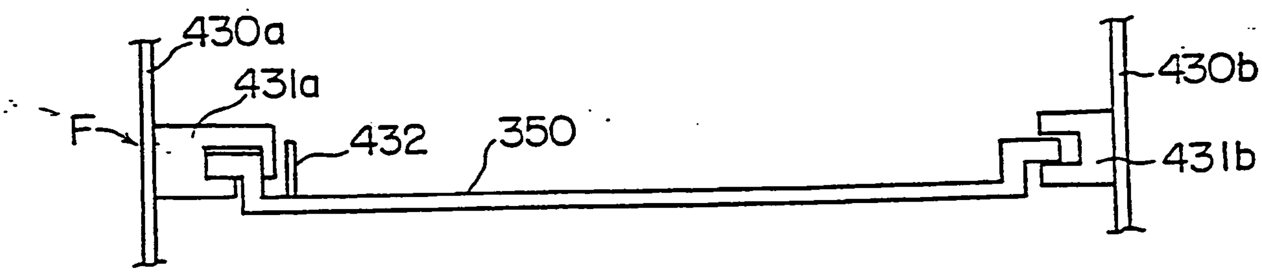

FIG. 36

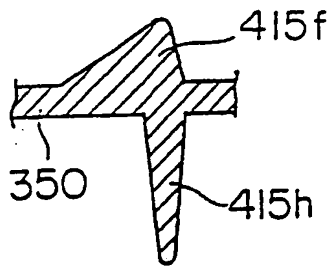

FIG. 37

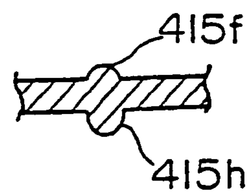

FIG. 38

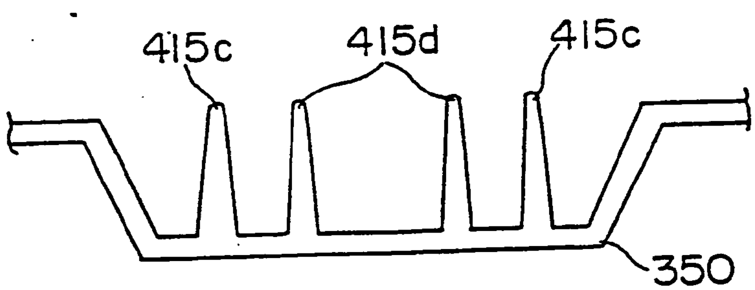

FIG. 39

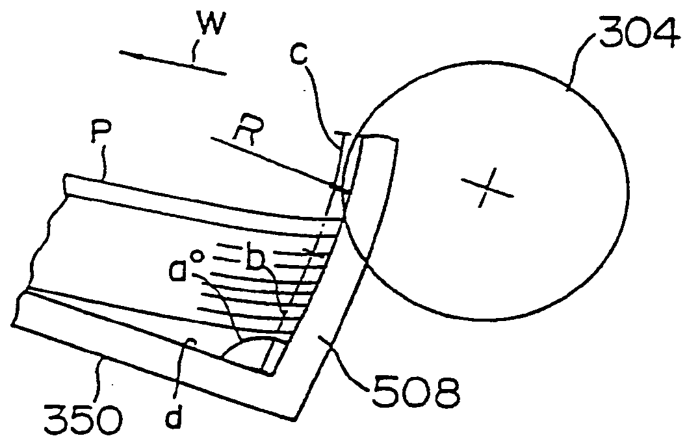

FIG. 40

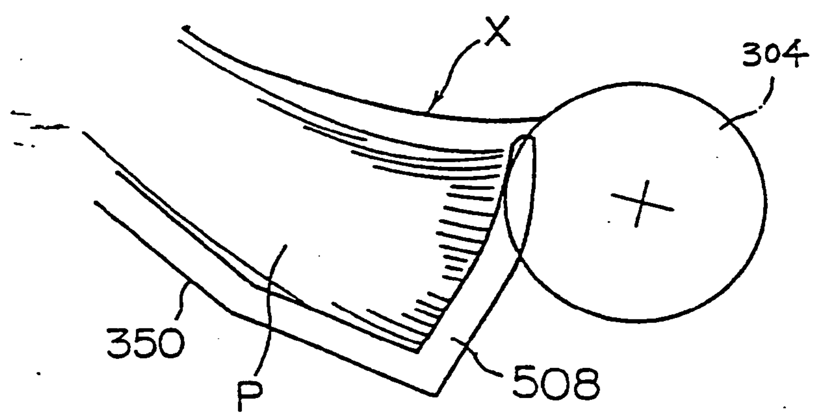

FIG. 41

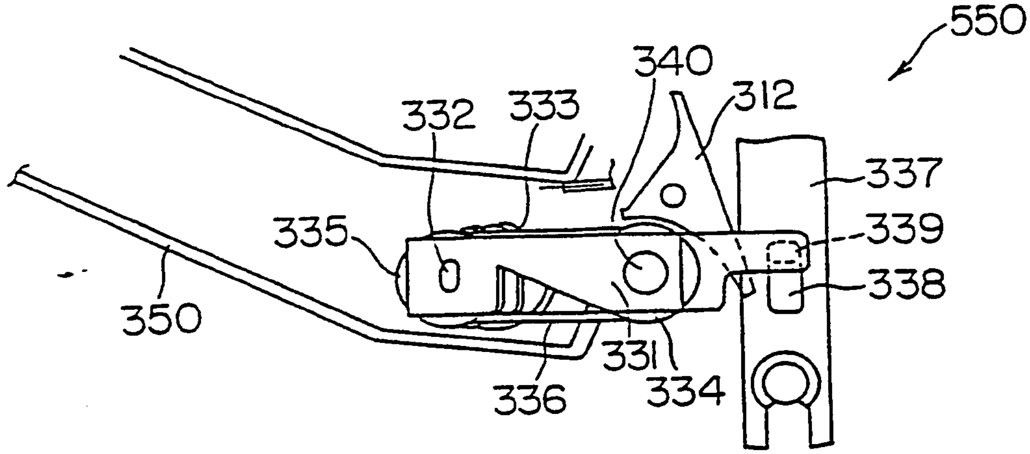
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FIG. 42

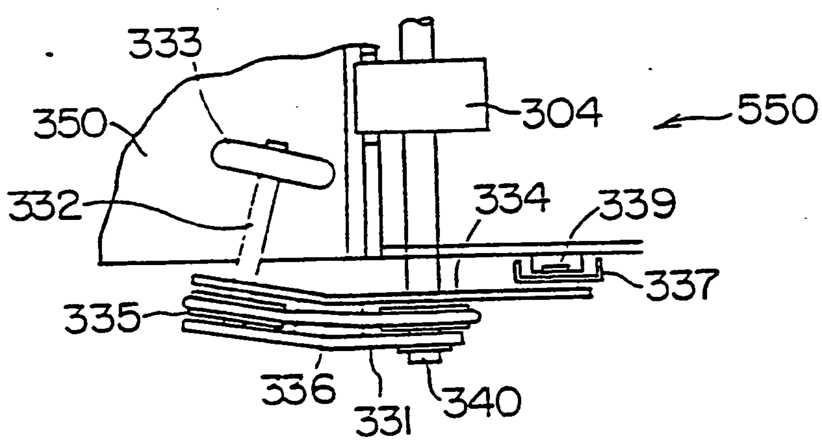
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FIG. 43

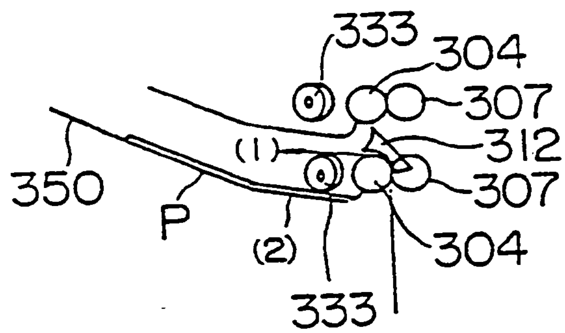


FIG. 44

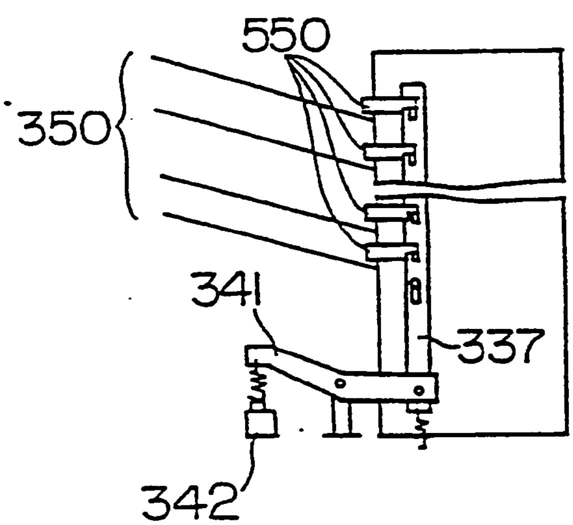


FIG. 45

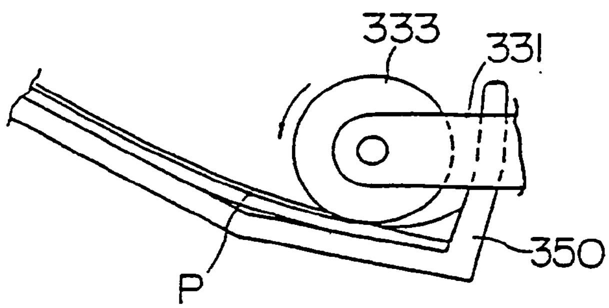


FIG. 46

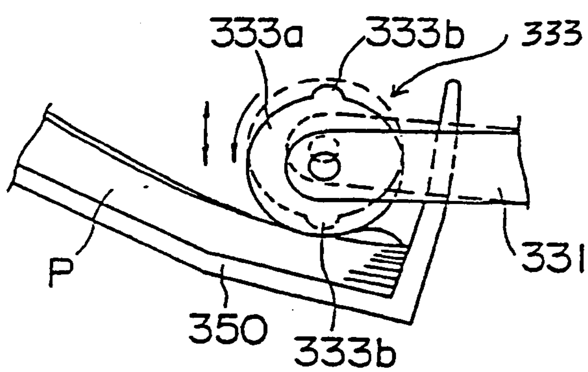


FIG. 47

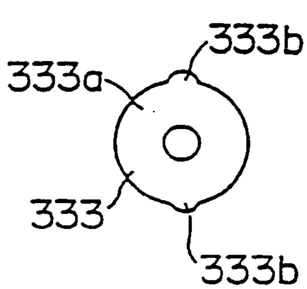


FIG. 48

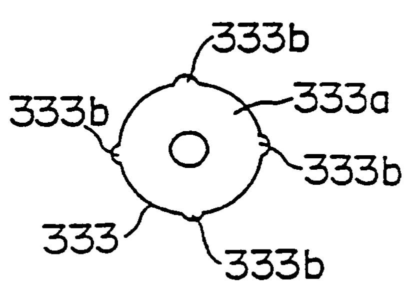
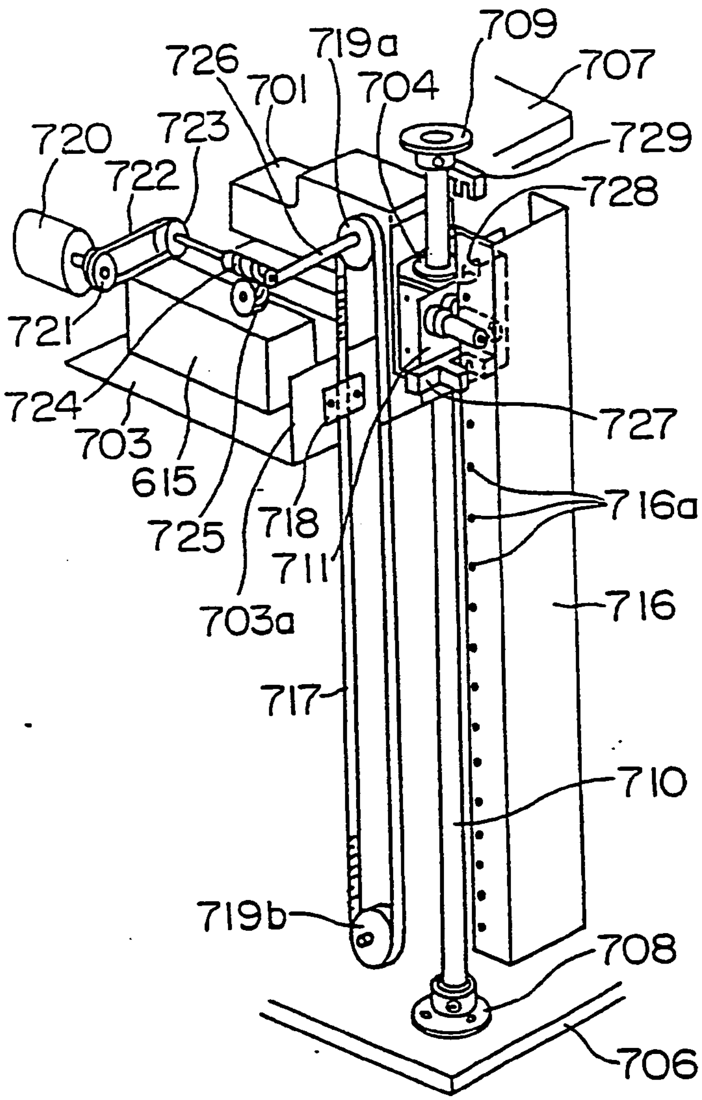


FIG. 49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719b
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706

FIG. 50

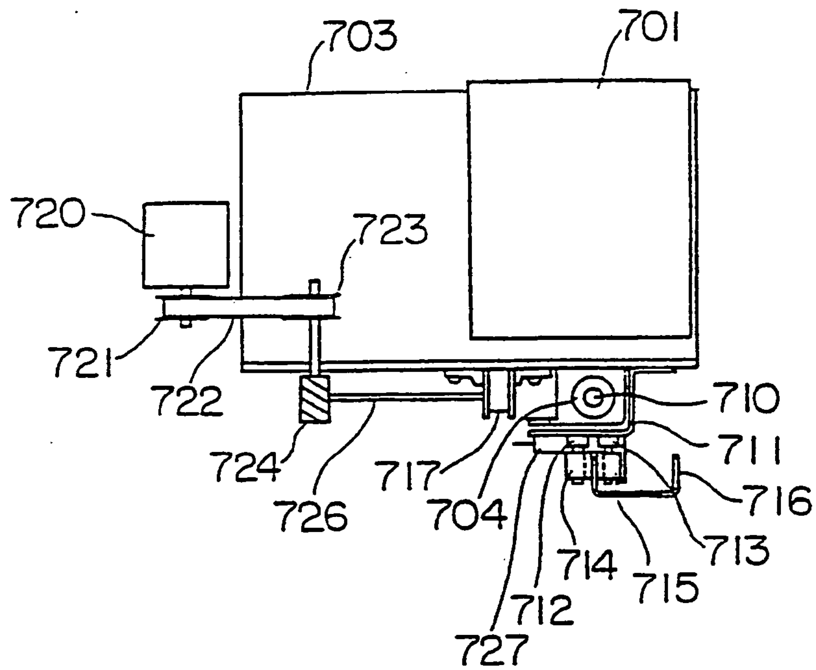

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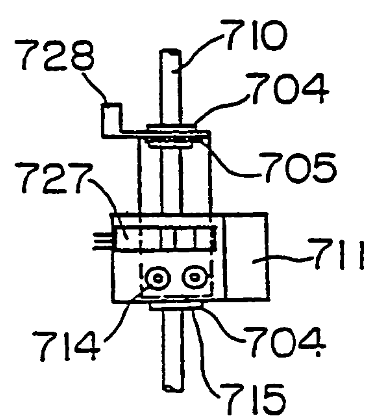
FIG. 51



710
728
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FIG. 52

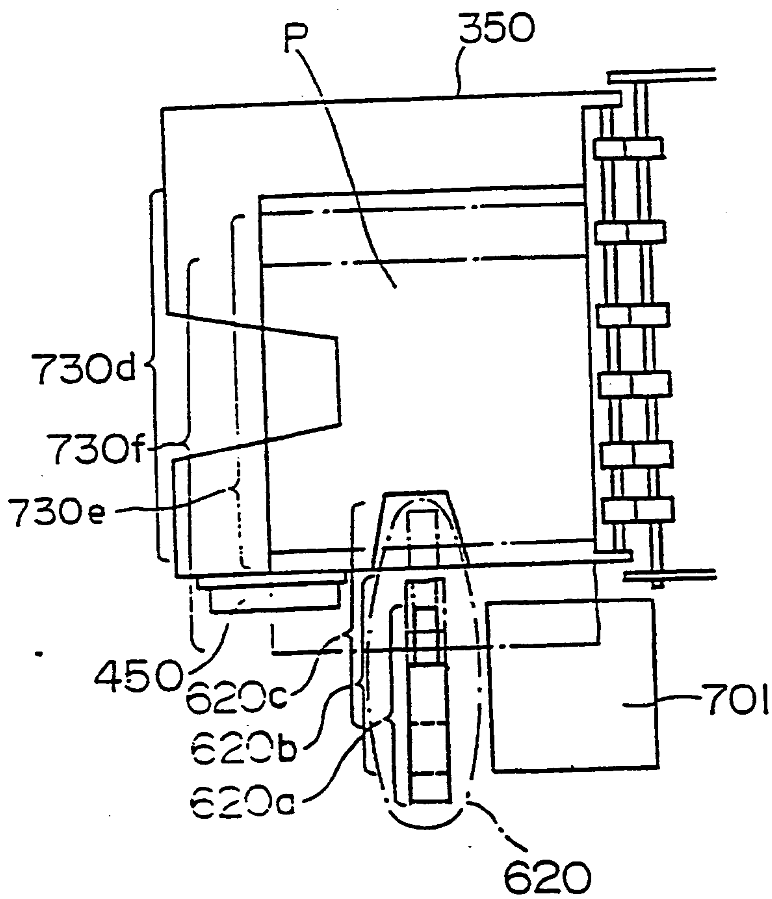

FIG. 53

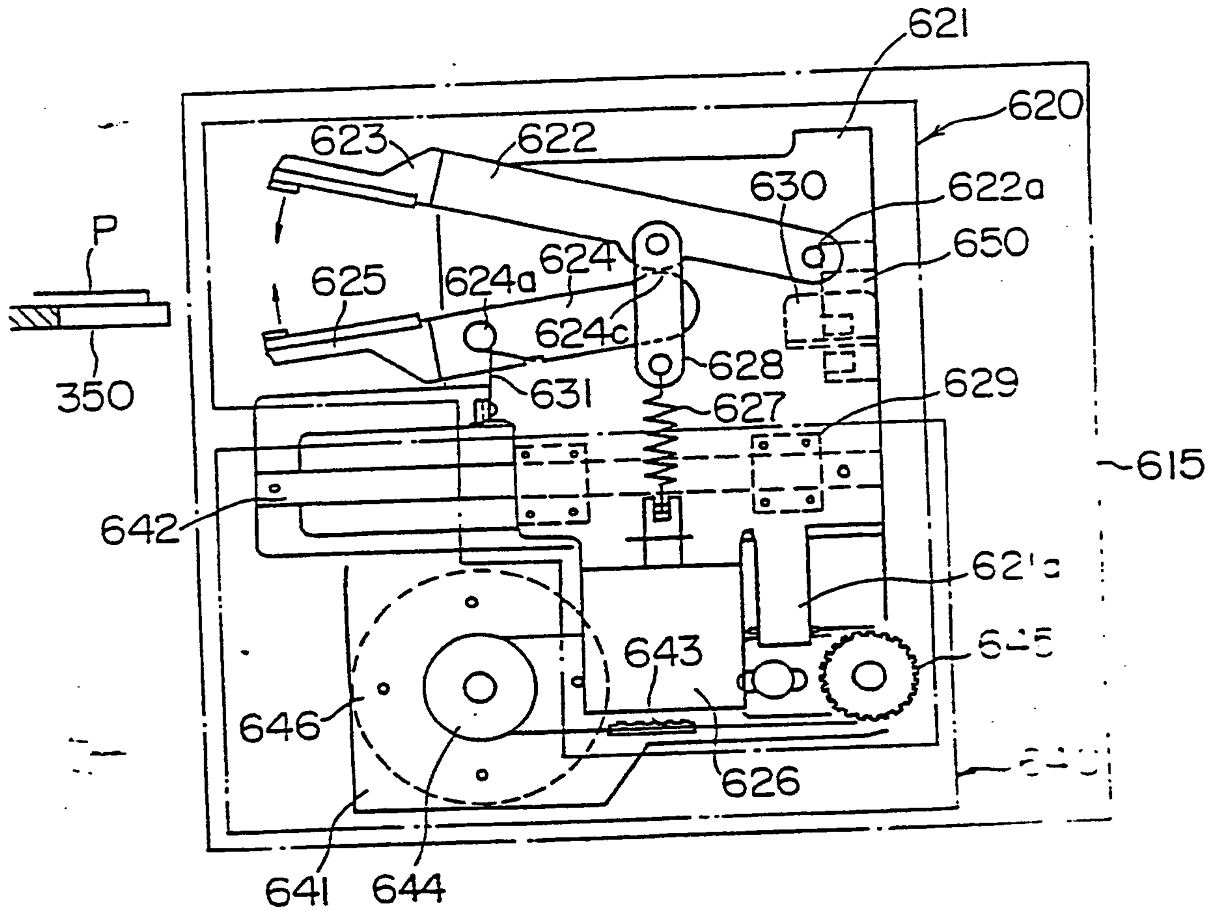
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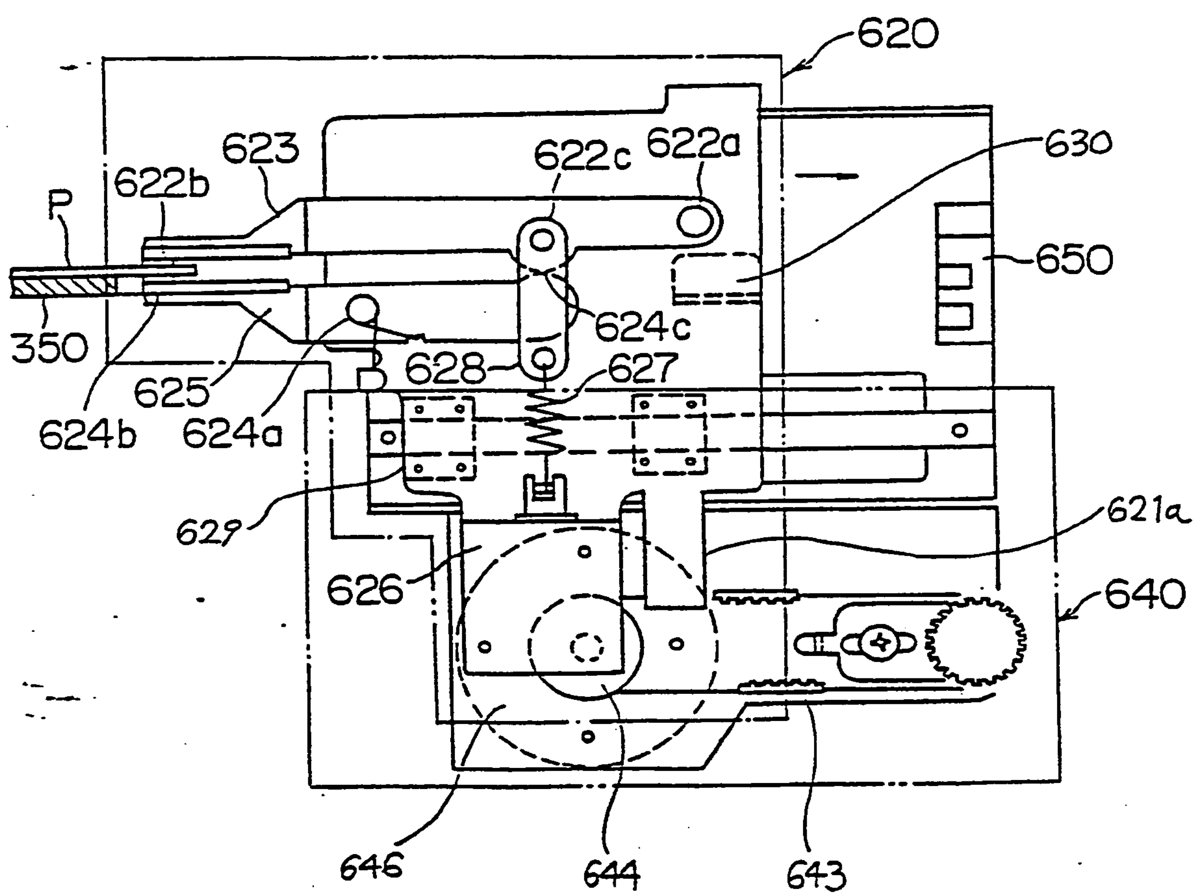
FIG. 54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622b
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621a
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643

FIG. 55

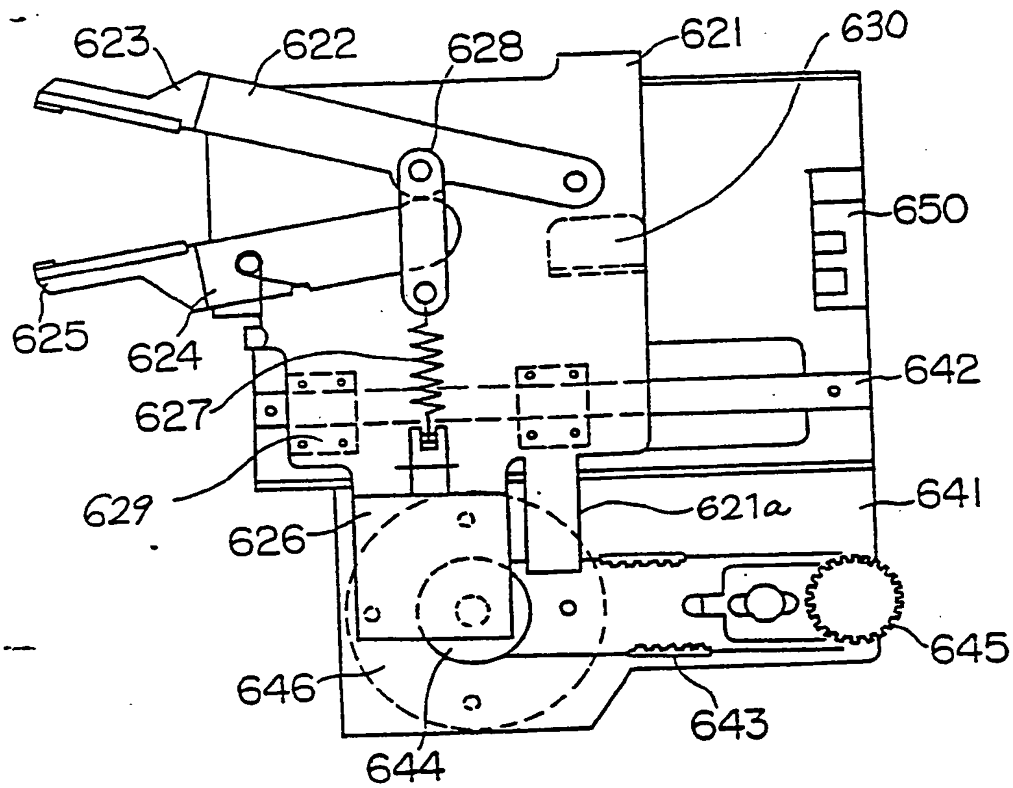
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FIG. 56

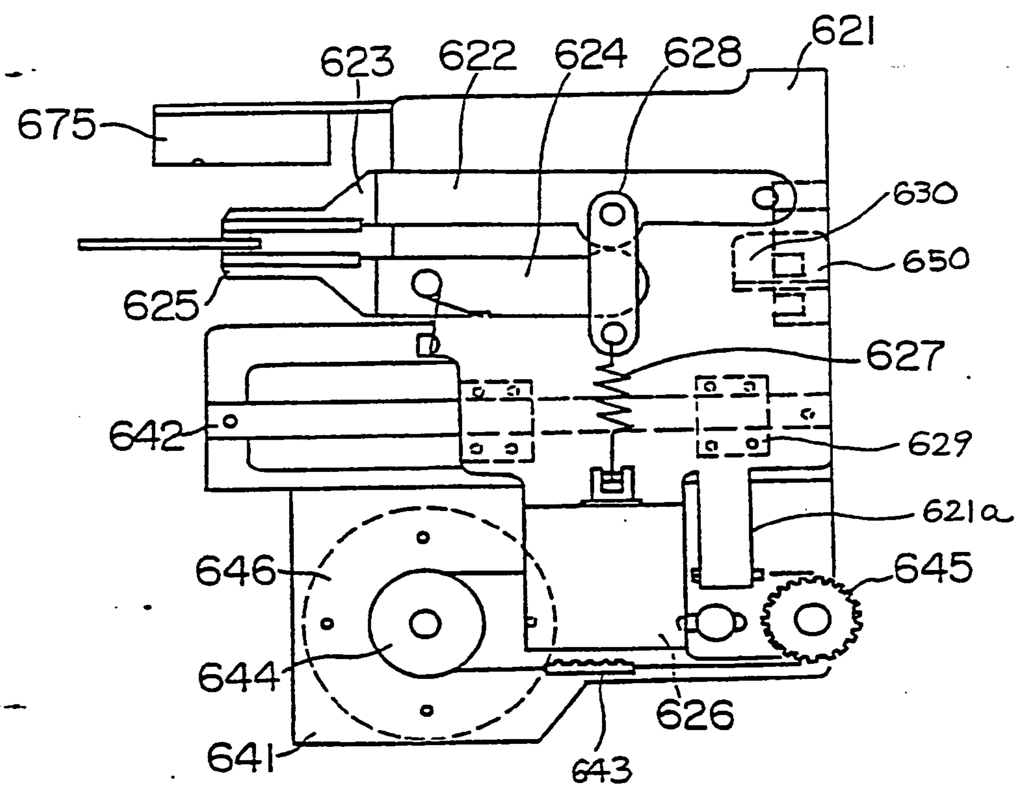

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FIG. 57

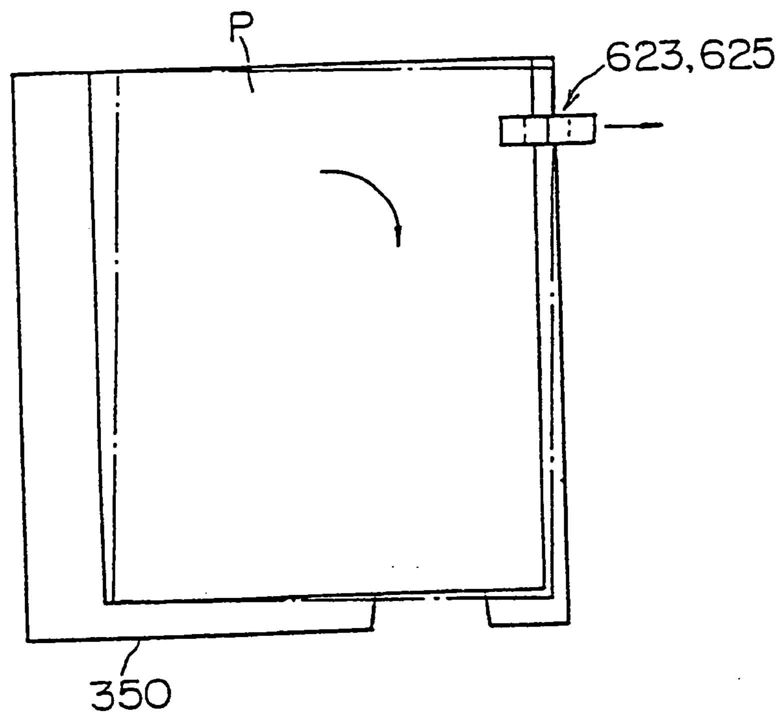


FIG. 58

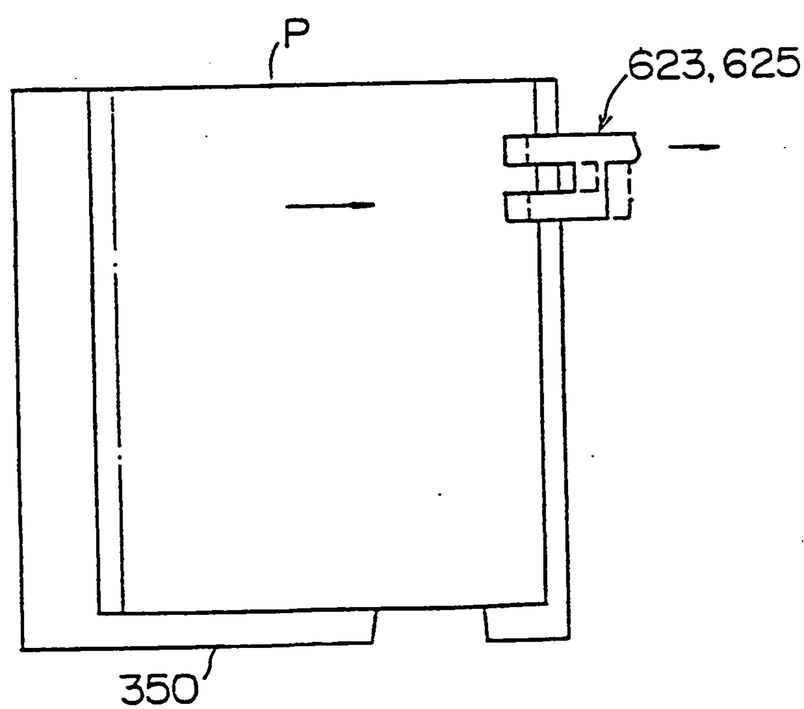


FIG. 59

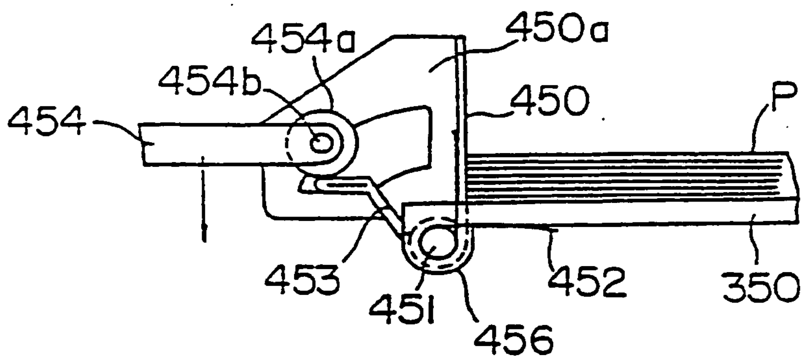

454a
450a
454b
450
454
P
453
451
456
452
350

FIG. 60

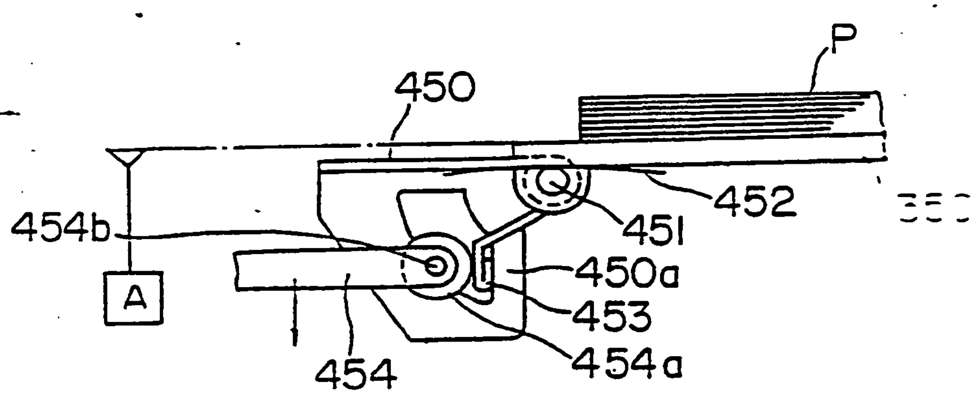

P
450
452
454b
451
450a
A
453
454
454a

FIG. 61

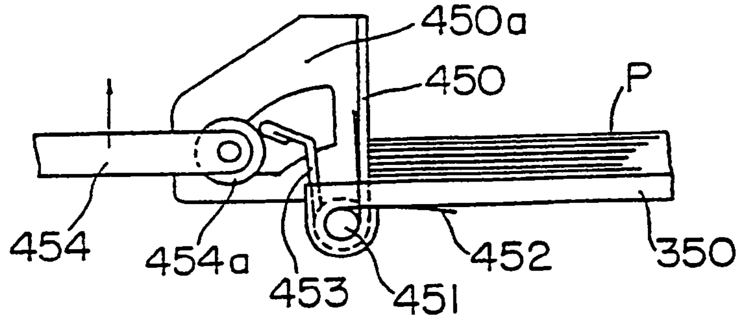


FIG. 62

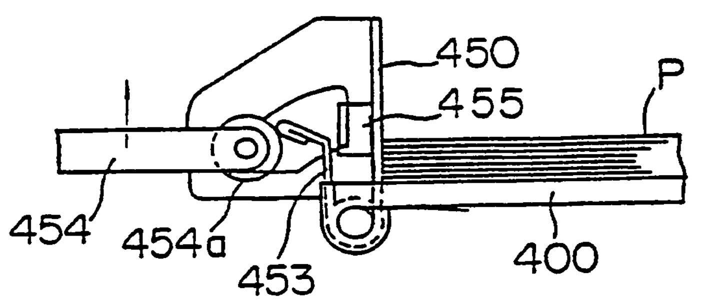


FIG. 63

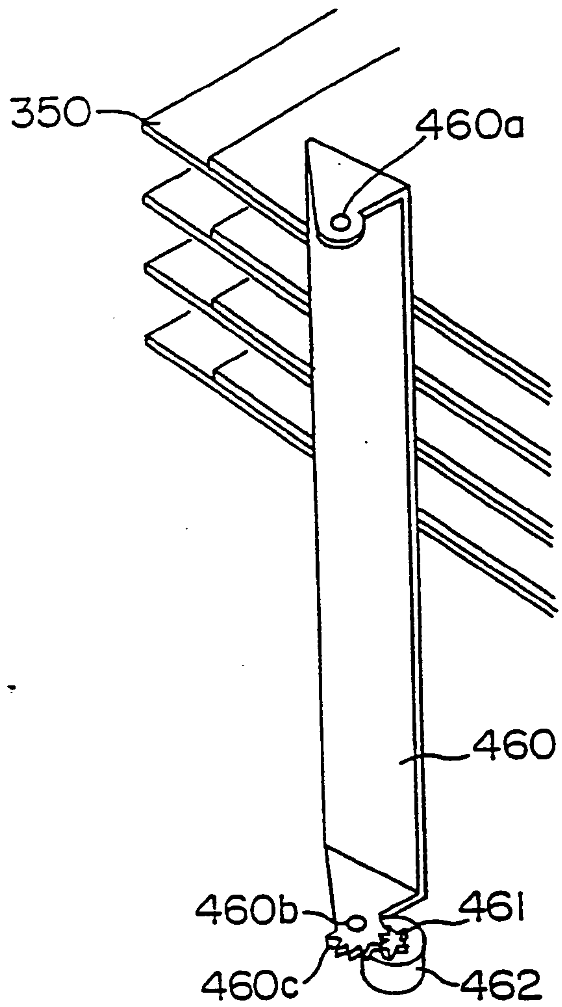


FIG. 64

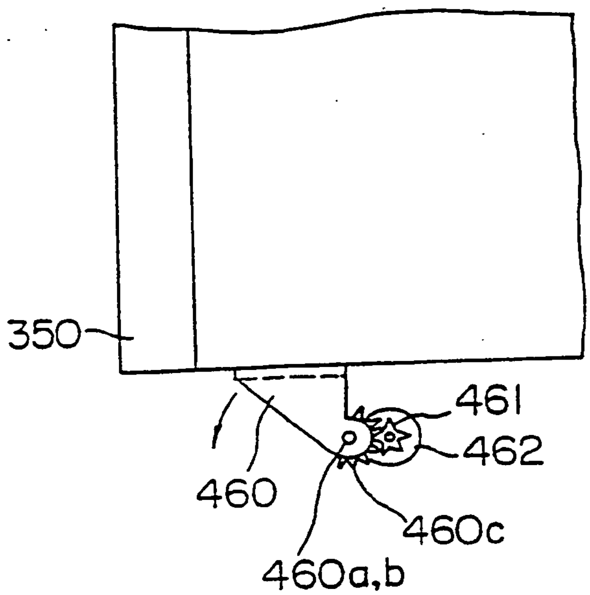


FIG. 66

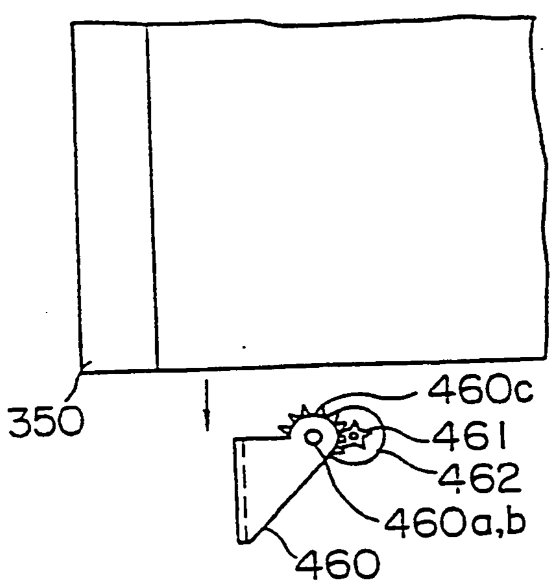


FIG. 65

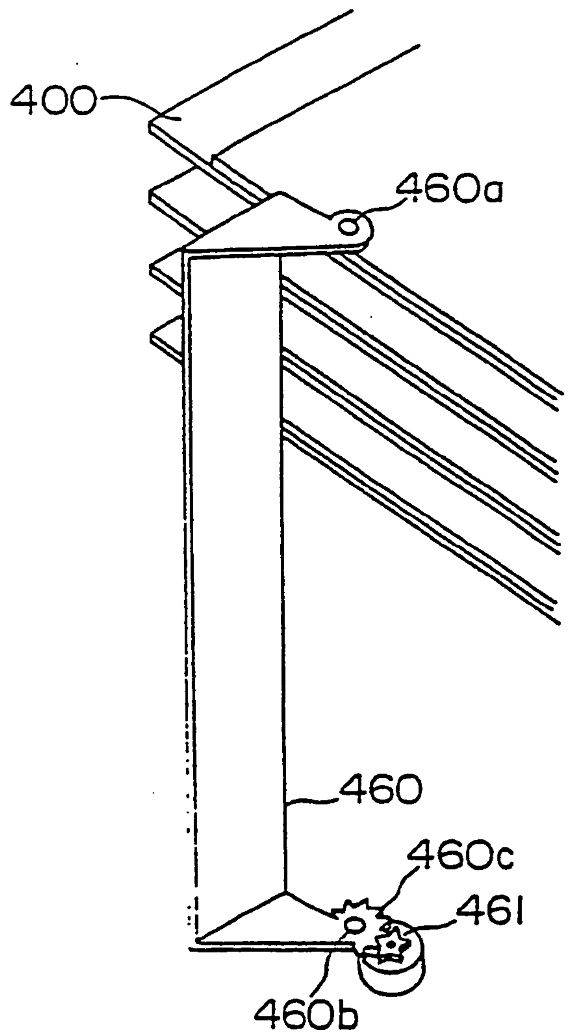


FIG. 67

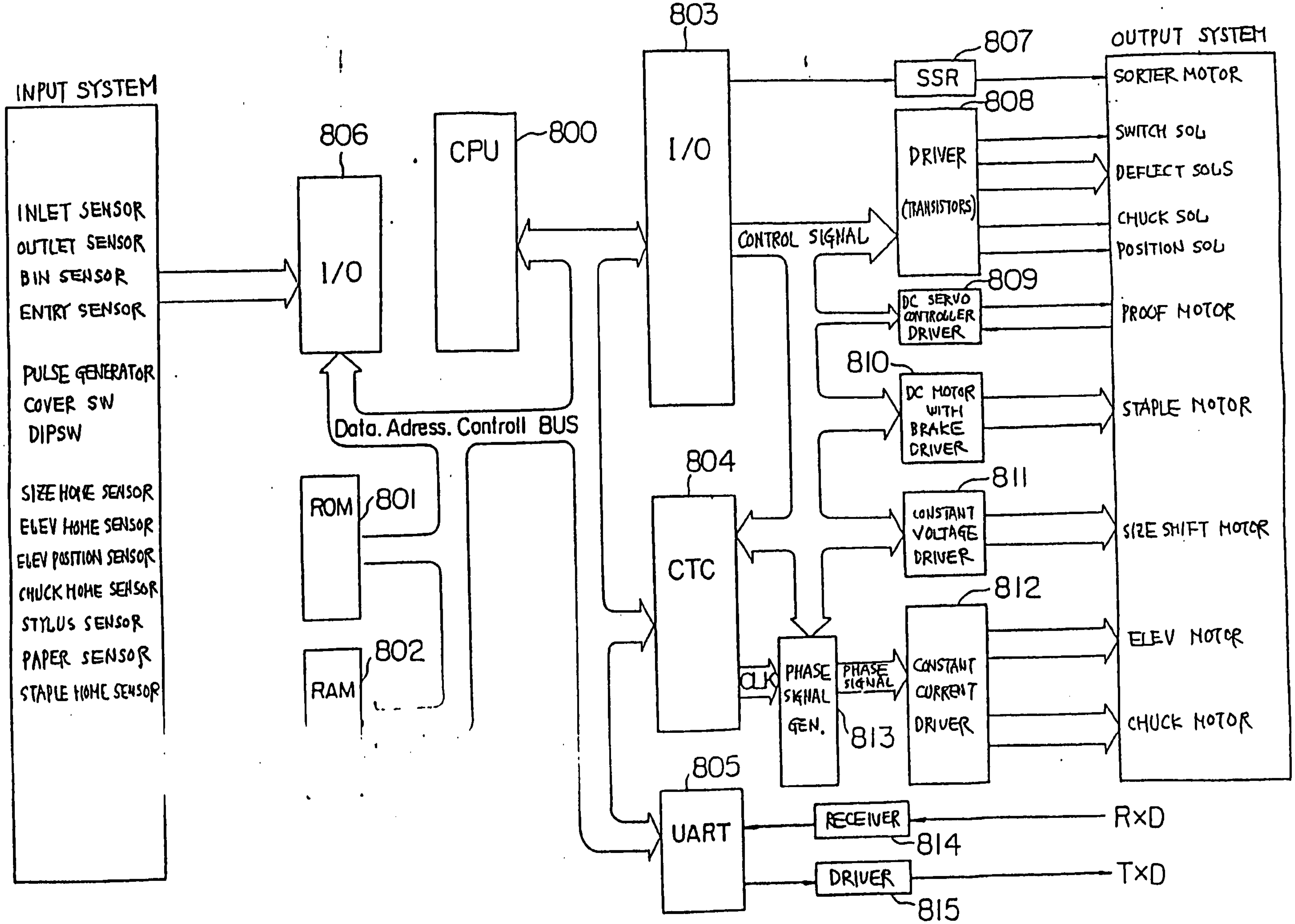

INPUT SYSTEM
INLET SENSOR
OUTLET SENSOR
BIN SENSOR
ENTRY SENSOR
PULSE GENERATOR
COVER SW
DIPSW
SIZE HOME SENSOR
ELEV HOME SENSOR
ELEV POSITION SENSOR
CHUCK HOME SENSOR
STYLUS SENSOR
PAPER SENSOR
STAPLE HOME SENSOR
806
I/O
CPU
800
Data. Adress. Controll BUS
ROM
801
RAM
802
803
I/O
CONTROL SIGNAL
804
CTC
805
UART
807
SSR
808
DRIVER
(TRANSISTORS)
809
DC SERVO CONTROLLER DRIVER
810
DC MOTOR WITH BRAKE DRIVER
811
CONSTANT VOLTAGE DRIVER
812
CONSTANT CURRENT DRIVER
CLK
PHASE SIGNAL GEN.
PHASE SIGNAL
813
RECEIVER
814
DRIVER
815
RxD
TxD
OUTPUT SYSTEM
SORTER MOTOR
SWITCH SOL
DEFLECT SOLS
CHUCK SOL
POSITION SOL
PROOF MOTOR
STAPLE MOTOR
SIZE SHIFT MOTOR
ELEV MOTOR
CHUCK MOTOR

FIG. 68A

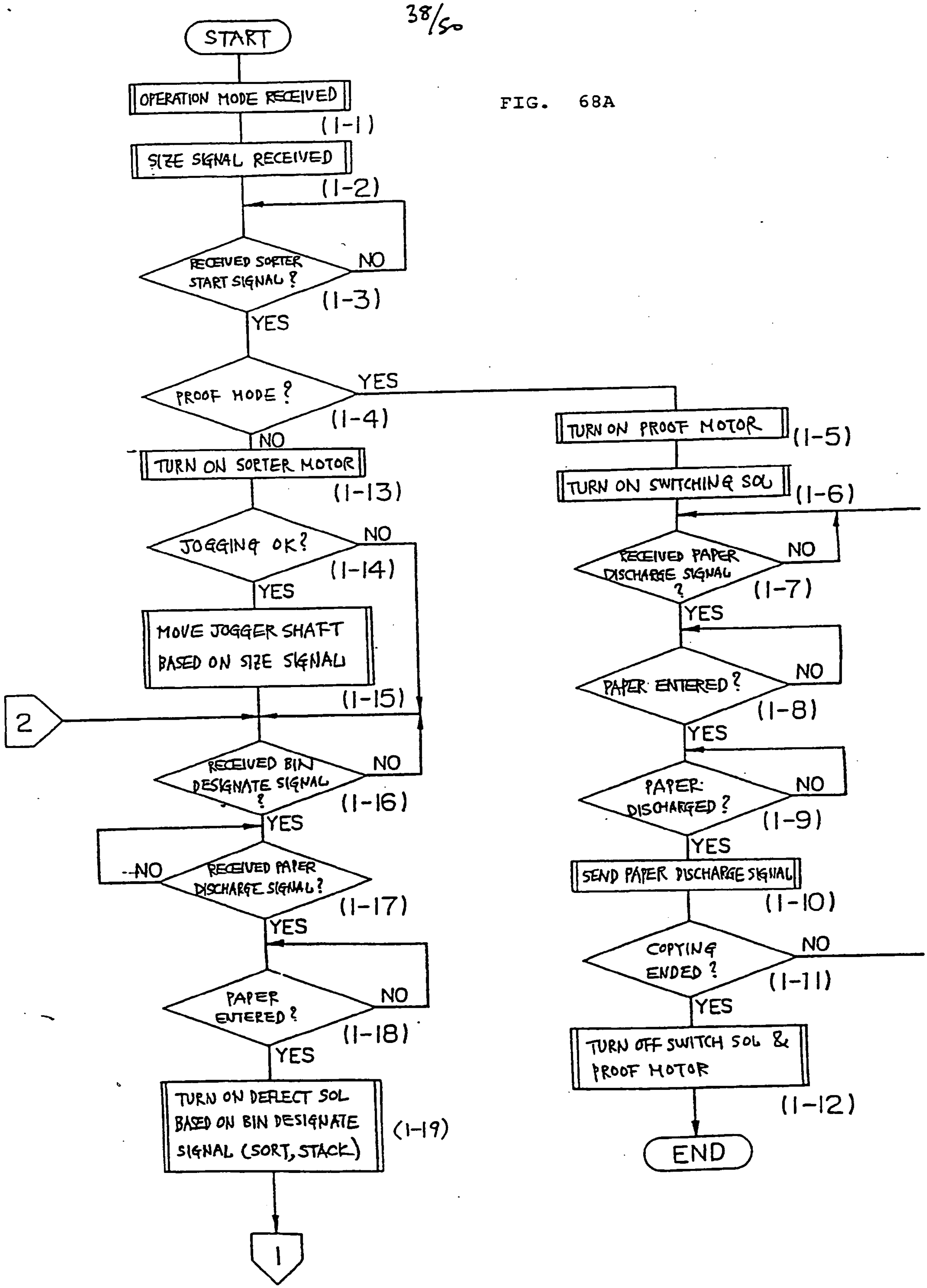

START
OPERATION MODE RECEIVED
(1-1)
SIZE SIGNAL RECEIVED
(1-2)
RECEIVED SORTER START SIGNAL ?
NO
(1-3)
YES
PROOF MODE ?
YES
(1-4)
NO
TURN ON SORTER MOTOR
(1-13)
JOGGING OK?
NO
(1-14)
YES
MOVE JOGGER SHAFT BASED ON SIZE SIGNAL
(1-15)
2
RECEIVED BIN DESIGNATE SIGNAL ?
NO
(1-16)
YES
RECEIVED PAPER DISCHARGE SIGNAL ?
NO
(1-17)
YES
PAPER ENTERED ?
NO
(1-18)
YES
TURN ON DEFLECT SOL BASED ON BIN DESIGNATE SIGNAL (SORT, STACK)
(1-19)
1
TURN ON PROOF MOTOR
(1-5)
TURN ON SWITCHING SOL
(1-6)
RECEIVED PAPER DISCHARGE SIGNAL ?
NO
(1-7)
YES
PAPER ENTERED ?
NO
(1-8)
YES
PAPER DISCHARGED ?
NO
(1-9)
YES
SEND PAPER DISCHARGE SIGNAL
(1-10)
COPYING ENDED ?
NO
(1-11)
YES
TURN OFF SWITCH SOL & PROOF MOTOR
(1-12)
END

FIG. 68B

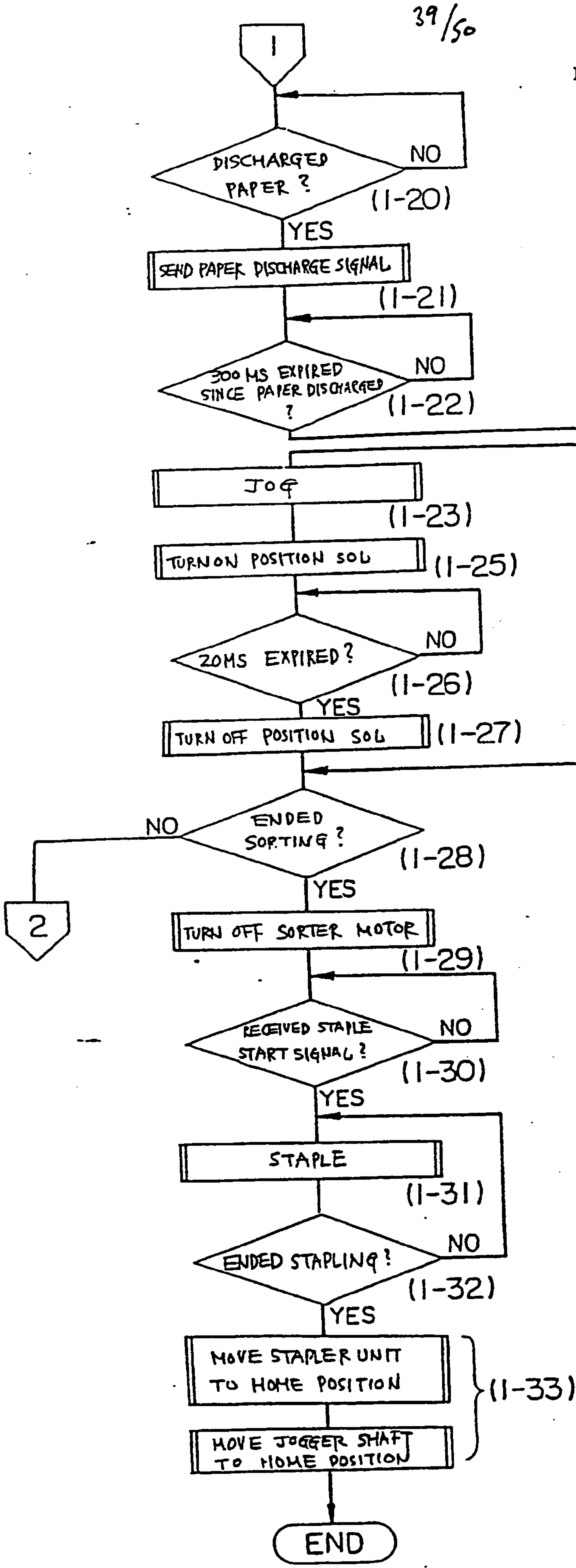

1
DISCHARGED PAPER ?
NO
(1-20)
YES
SEND PAPER DISCHARGE SIGNAL
(1-21)
300 MS EXPIRED SINCE PAPER DISCHARGED ?
NO
(1-22)
JOG
(1-23)
YES
JOGGING OK ?
(1-24)
NO
TURN ON POSITION SOL
(1-25)
20MS EXPIRED ?
NO
(1-26)
YES
TURN OFF POSITION SOL
(1-27)
NO
ENDED SORTING ?
(1-28)
2
YES
TURN OFF SORTER MOTOR
(1-29)
RECEIVED STAPLE START SIGNAL ?
NO
(1-30)
YES
STAPLE
(1-31)
ENDED STAPLING ?
NO
(1-32)
YES
MOVE STAPLER UNIT TO HOME POSITION
MOVE JOGGER SHAFT TO HOME POSITION
(1-33)
END

FIG. 69

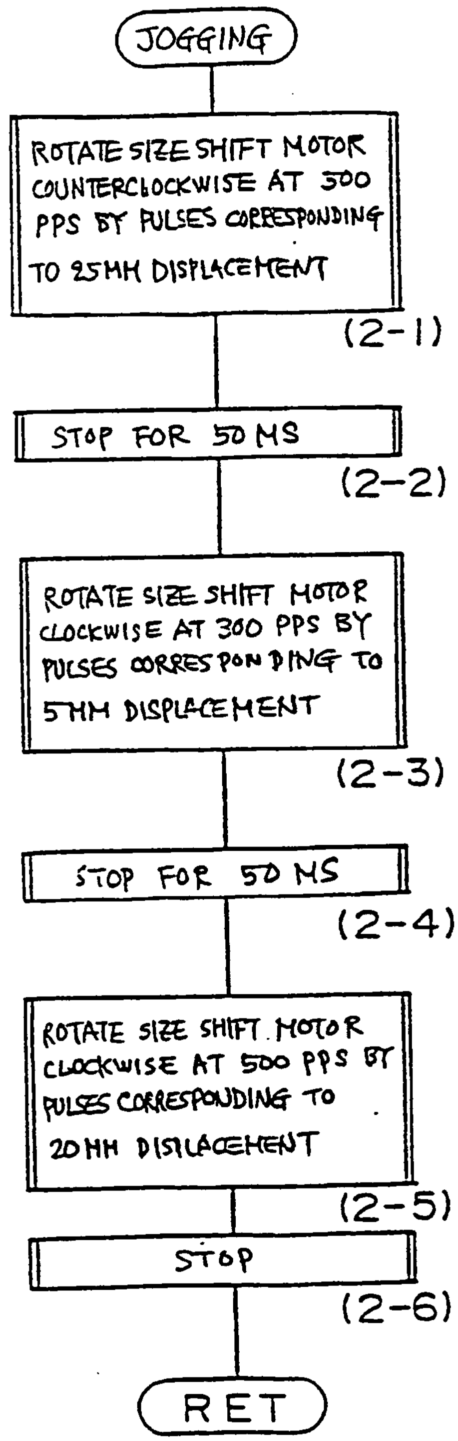

JOGGING
ROTATE SIZE SHIFT MOTOR COUNTERCLOCKWISE AT 300 PPS BY PULSES CORRESPONDING TO 25MM DISPLACEMENT
(2-1)
STOP FOR 50 MS
(2-2)
ROTATE SIZE SHIFT MOTOR CLOCKWISE AT 300 PPS BY PULSES CORRESPONDING TO 5MM DISPLACEMENT
(2-3)
STOP FOR 50 MS
(2-4)
ROTATE SIZE SHIFT MOTOR CLOCKWISE AT 500 PPS BY PULSES CORRESPONDING TO 20MM DISPLACEMENT
(2-5)
STOP
(2-6)
RET

FIG. 70

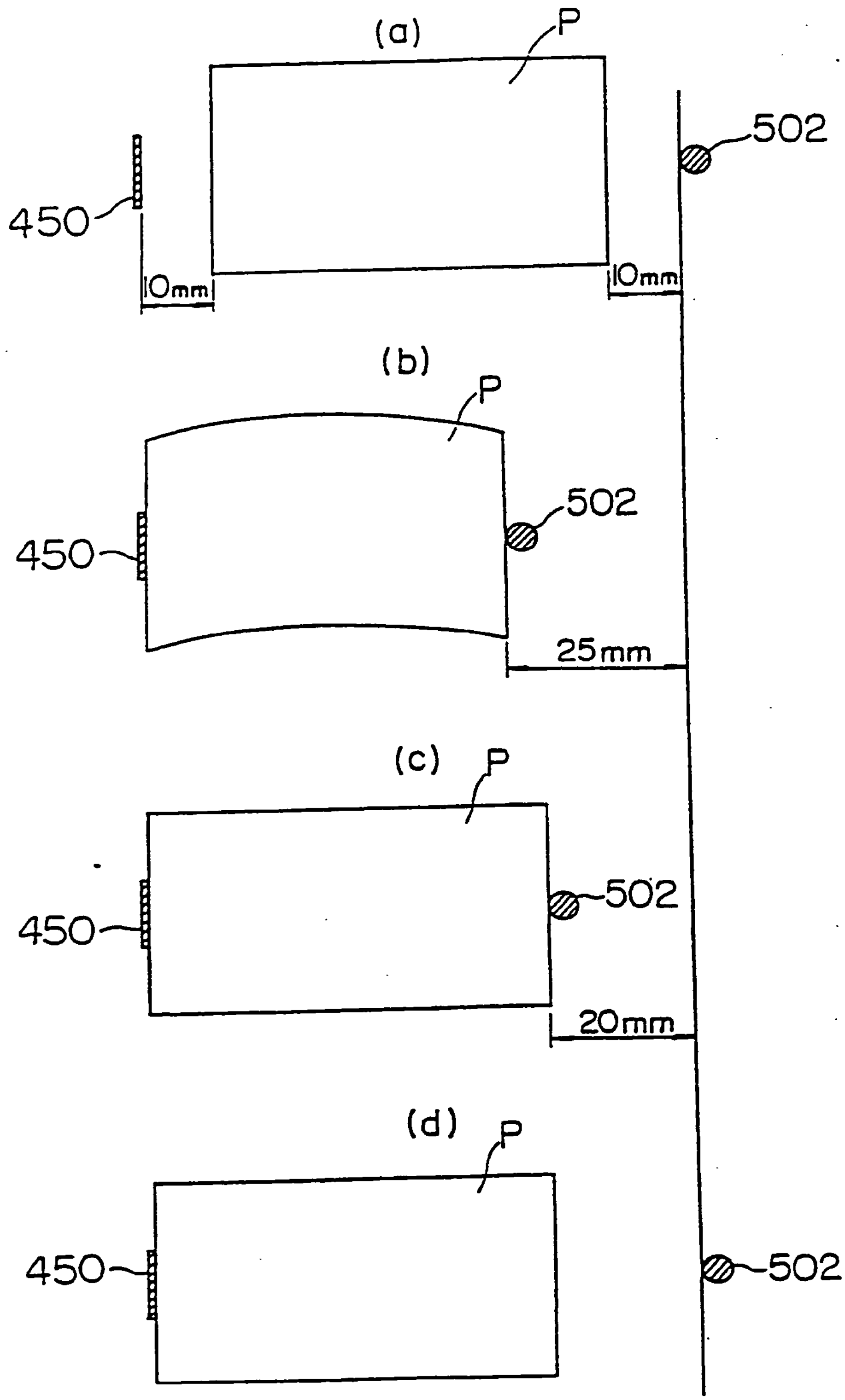


FIG. 71

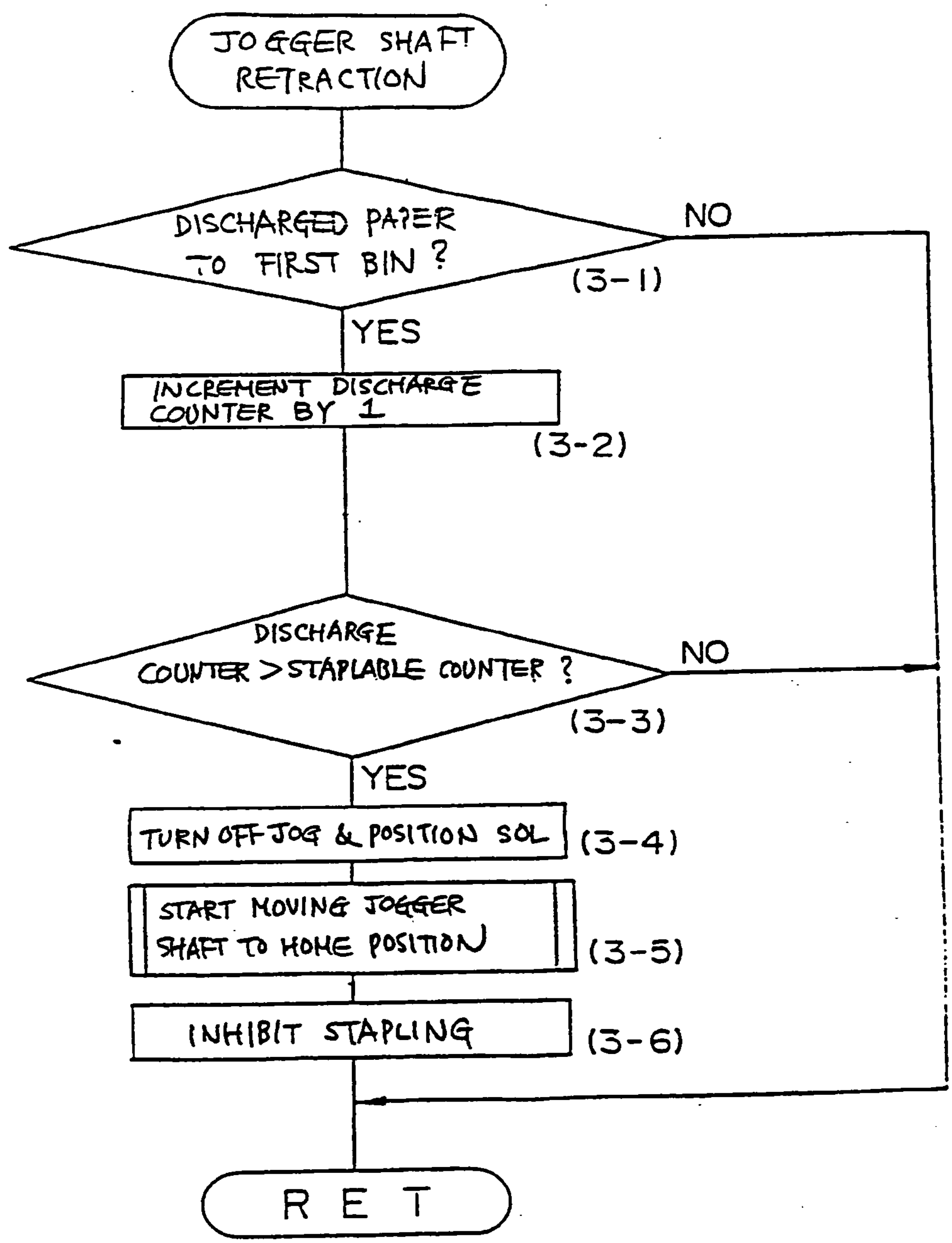
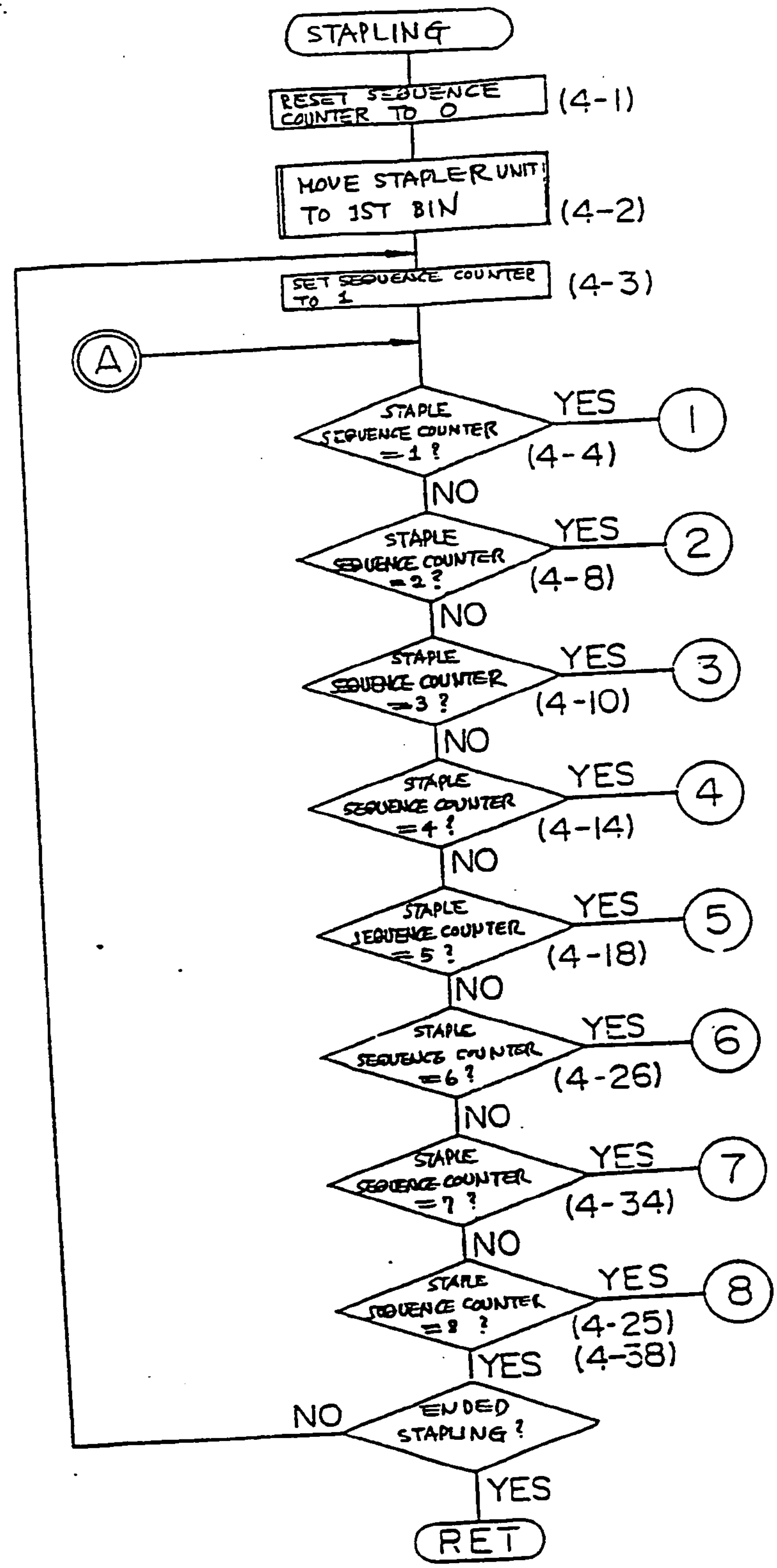

JOGGER SHAFT RETRACTION
DISCHARGED PAPER TO FIRST BIN ?
NO
(3-1)
YES
INCREMENT DISCHARGE COUNTER BY 1
(3-2)
DISCHARGE COUNTER > STAPLABLE COUNTER ?
NO
(3-3)
YES
TURN OFF JOG & POSITION SOL
(3-4)
START MOVING JOGGER SHAFT TO HOME POSITION
(3-5)
INHIBIT STAPLING
(3-6)
RET

FIG. 72A



STAPLING
RESET SEQUENCE COUNTER TO 0
(4-1)
MOVE STAPLER UNIT TO 1ST BIN
(4-2)
SET SEQUENCE COUNTER TO 1
(4-3)
A
STAPLE SEQUENCE COUNTER =1 ?
YES
1
(4-4)
NO
STAPLE SEQUENCE COUNTER =2 ?
YES
2
(4-8)
NO
STAPLE SEQUENCE COUNTER =3 ?
YES
3
(4-10)
NO
STAPLE SEQUENCE COUNTER =4 ?
YES
4
(4-14)
NO
STAPLE SEQUENCE COUNTER =5 ?
YES
5
(4-18)
NO
STAPLE SEQUENCE COUNTER =6 ?
YES
6
(4-26)
NO
STAPLE SEQUENCE COUNTER =7 ?
YES
7
(4-34)
NO
STAPLE SEQUENCE COUNTER =8 ?
YES
8
(4-25)
(4-38)
YES
NO
ENDED STAPLING ?
YES
RET

FIG. 72B

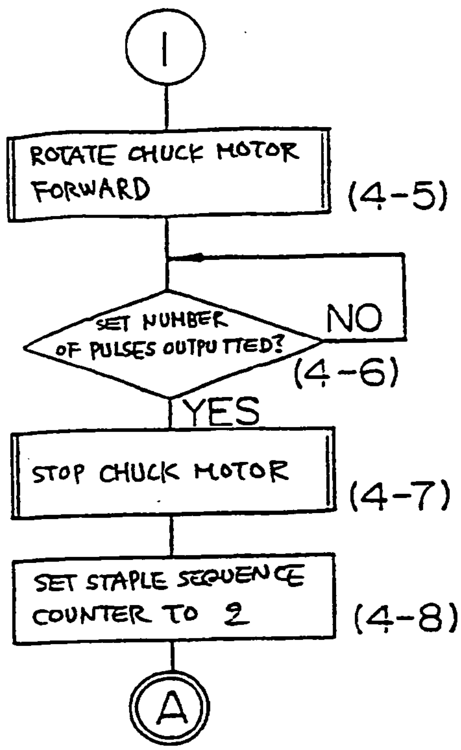


FIG. 72C

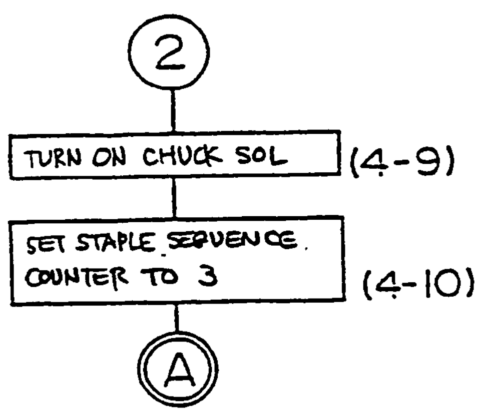


FIG. 72D

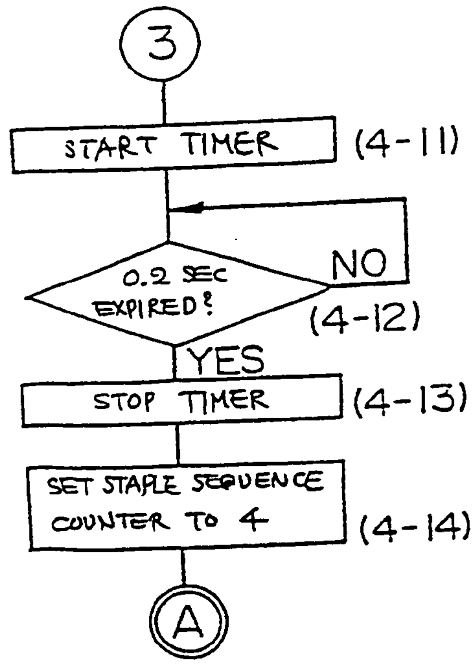


FIG. 72E

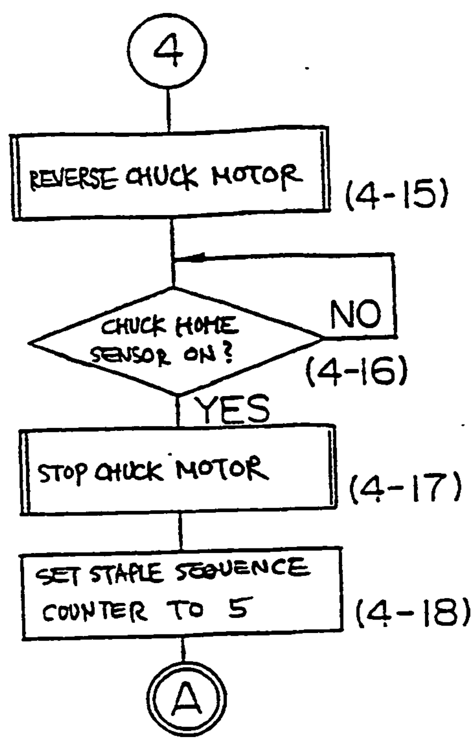


FIG. 72F

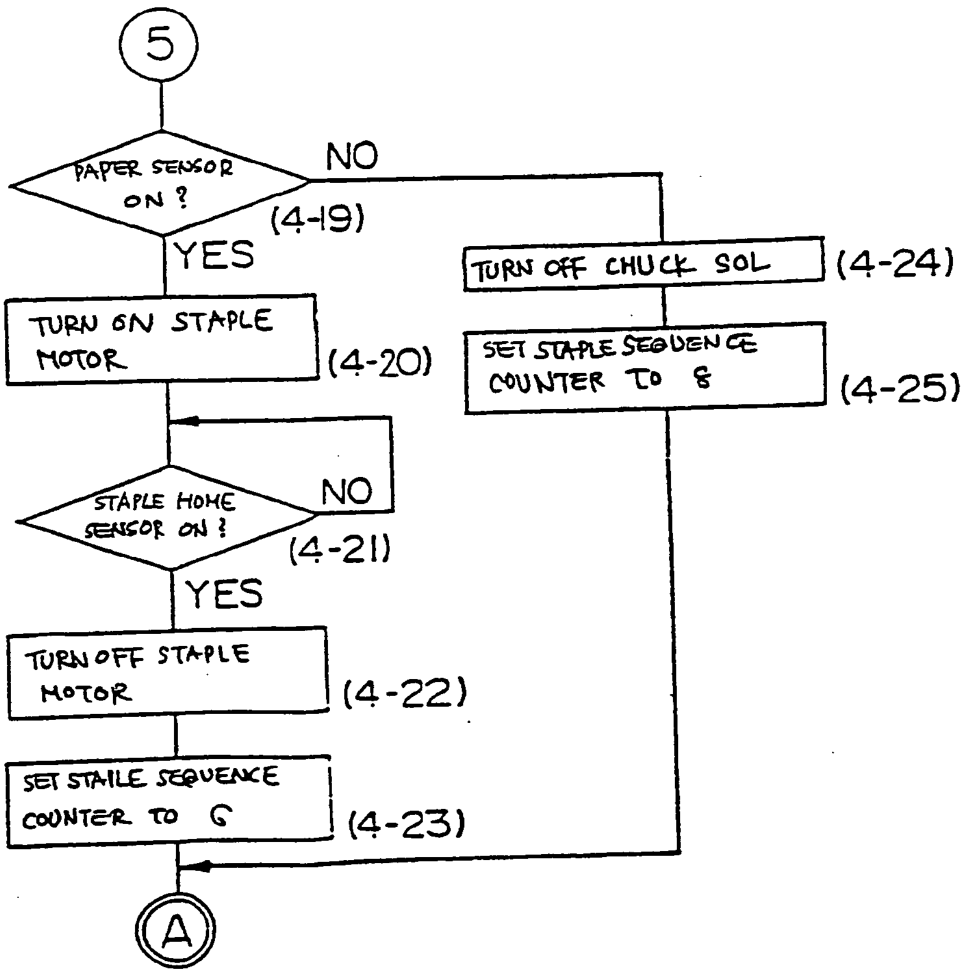

5
PAPER SENSOR ON ?
(4-19)
NO
YES
TURN ON STAPLE MOTOR
(4-20)
STAPLE HOME SENSOR ON ?
(4-21)
NO
YES
TURN OFF STAPLE MOTOR
(4-22)
SET STAILE SEQUENCE COUNTER TO 6
(4-23)
TURN OFF CHUCK SOL
(4-24)
SET STAPLE SEQUENCE COUNTER TO 8
(4-25)
A

FIG. 72G

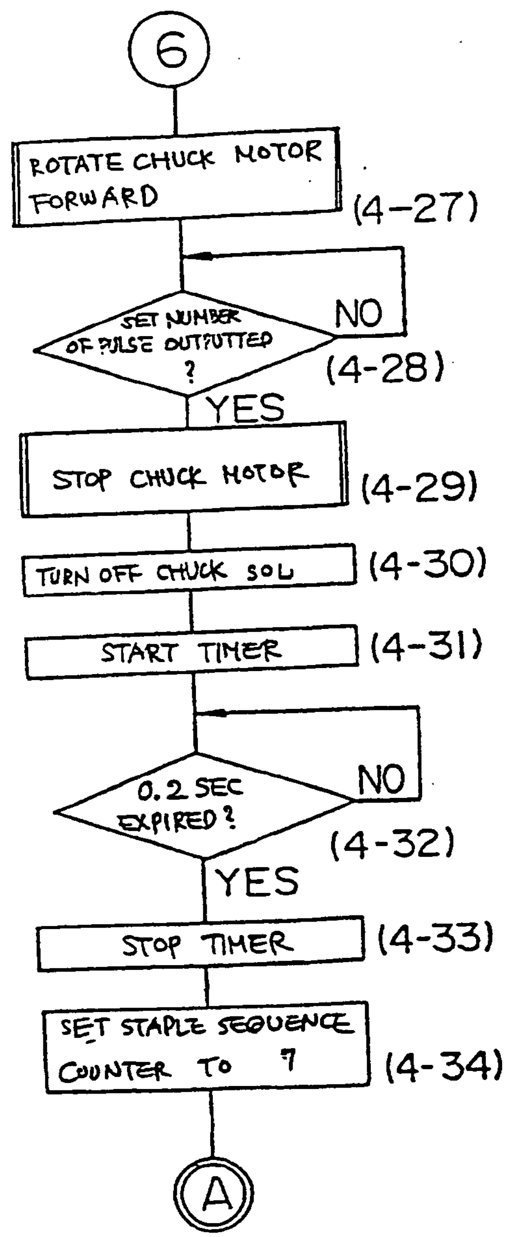

6
ROTATE CHUCK MOTOR FORWARD
(4-27)
SET NUMBER OF PULSE OUTPUTTED ?
NO
(4-28)
YES
STOP CHUCK MOTOR
(4-29)
TURN OFF CHUCK SOL
(4-30)
START TIMER
(4-31)
0.2 SEC EXPIRED ?
NO
(4-32)
YES
STOP TIMER
(4-33)
SET STAPLE SEQUENCE COUNTER TO 7
(4-34)
A

FIG. 72H

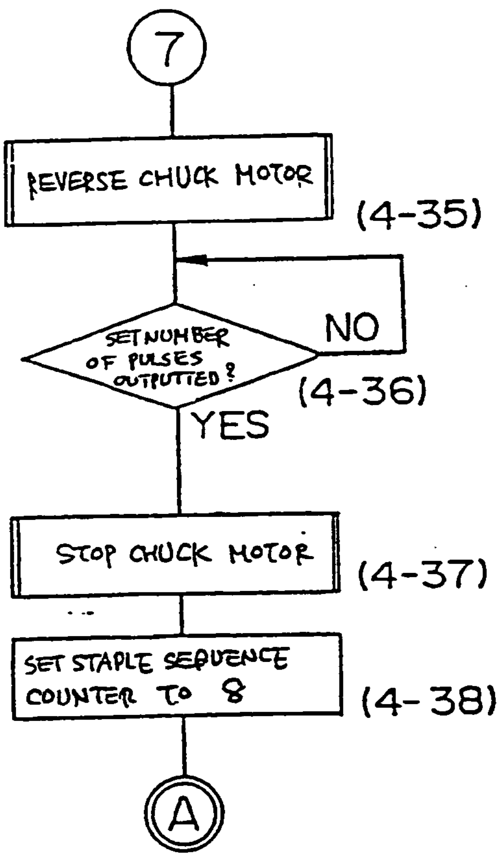


FIG. 72I

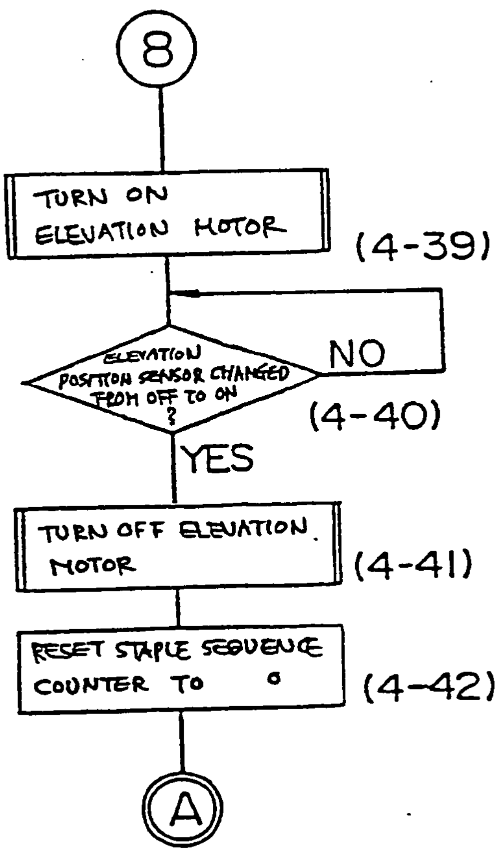


FIG. 73

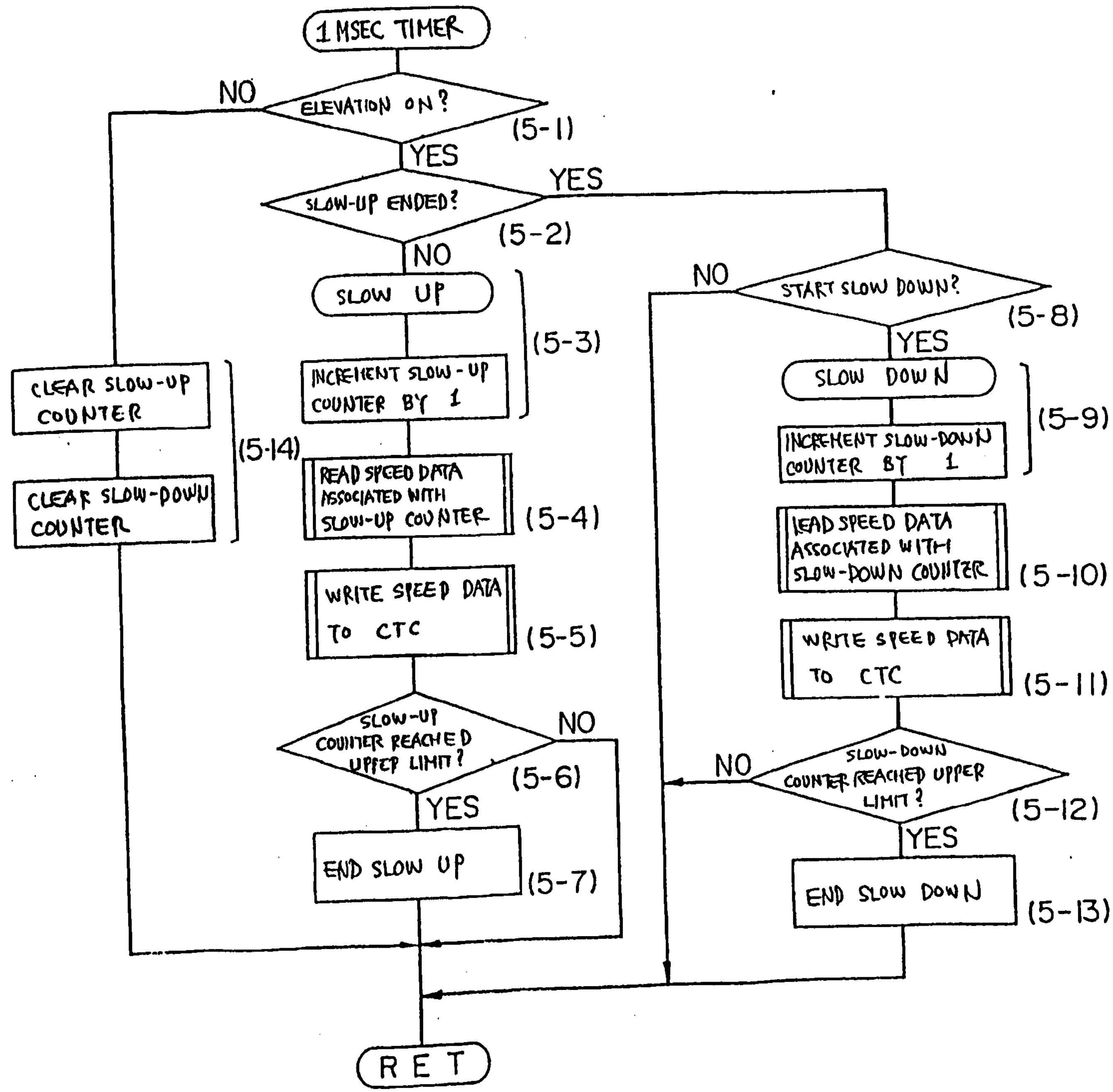

1 MSEC TIMER
ELEVATION ON?
(5-1)
NO
YES
SLOW-UP ENDED?
(5-2)
NO
YES
SLOW UP
INCREMENT SLOW-UP COUNTER BY 1
(5-3)
READ SPEED DATA ASSOCIATED WITH SLOW-UP COUNTER
(5-4)
WRITE SPEED DATA TO CTC
(5-5)
SLOW-UP COUNTER REACHED UPPER LIMIT?
(5-6)
NO
YES
END SLOW UP
(5-7)
START SLOW DOWN?
(5-8)
NO
YES
SLOW DOWN
INCREMENT SLOW-DOWN COUNTER BY 1
(5-9)
READ SPEED DATA ASSOCIATED WITH SLOW-DOWN COUNTER
(5-10)
WRITE SPEED DATA TO CTC
(5-11)
SLOW-DOWN COUNTER REACHED UPPER LIMIT?
(5-12)
NO
YES
END SLOW DOWN
(5-13)
CLEAR SLOW-UP COUNTER
CLEAR SLOW-DOWN COUNTER
(5-14)
RET

FIG. 74

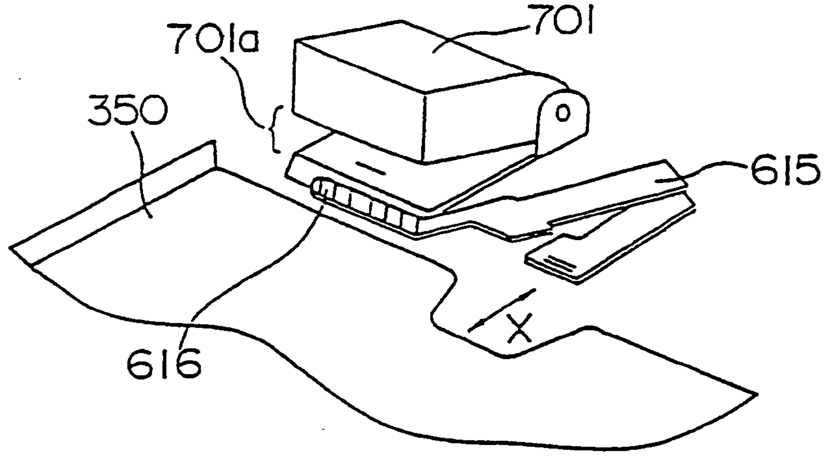
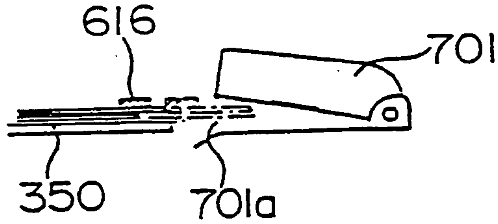


FIG. 75



FINISHER FOR FINISHING PAPER SHEETS

The present invention relates to a paper handling apparatus or so-called finisher having a stapler for stapling a stack of paper sheets transported to a copy tray incorporated in, for example, a copier, facsimile machine or printer or to a bin of a sorter. More particularly, the present invention is concerned with a finisher having a paper positioning device capable of positioning paper sheets positively and accurately in spite of the elasticity of the sheets.

According to one aspect of the present invention there is provided a finisher for finishing paper sheets, comprising:

a sorter comprising a plurality of bins arranged one above another for receiving paper sheets to be transported one after another thereto;

a stapler for stapling a stack of the paper sheets discharged onto each of said bins, each bin comprising

a paper positioning device for positioning paper sheets on said bin;

said paper positioning device comprising a fence extending along one side edge of said bin, and a positioning member reciprocatingly movable from a standby position towards said fence and towards said standby position away from said fence, said positioning member being adapted to stop in at least a first stop position, a

second stop position and a third stop position to position a stack of paper sheets.

According to a second aspect of the present invention there is provided a finisher for finishing paper sheets, comprising:

a tray for stacking paper sheets to be transported thereto;

a fence provided on said tray and extending along one side edge of said tray; and

a positioning member reciprocatingly movable from a standby position towards said fence and towards said standby position away from said fence and adapted to stop in at least a first stop position, a second stop position and a third stop position for positioning the paper sheets.

The invention will further be understood from the following description when taken with the accompanying drawings which are given by way of example only and in which:

Figs. 1 and 2 show different prior art paper pulling devices working on curled paper sheets;

Fig. 3 is an external perspective view of a prior art paper pulling device;

Fig. 4 is a side elevation showing a prior art mechanism for pressing paper sheets;

Fig. 5 is a front view of the finisher in accordance with the present invention;

Fig. 6 is a plan view of the finisher of Figure 5;

Fig. 7 is a front view of an upper transport section included in the embodiment;

Fig. 8A is a side elevation of the upper transport section;

Fig. 8B is a plan view of a guide portion included in the upper transport section;

Fig. 9 is a view representative of a drive system associated with the upper transport section;

Fig. 10 is a front view showing another specific

configuration of the upper transport section;

Fig. 11 is a side elevation of skew rollers;

Fig. 12 is an enlarged view of a driven ball and its associated elements;

Fig. 13 is a view showing a drive system associated with a skew section;

Fig. 14 is an enlarged front view of a drive transmitting arrangement;

Fig. 15 is a view demonstrating skewing;

Fig. 16 is a partly sectional view of a reference guide portion;

Fig. 17 is a perspective view of a jogging device;

Fig. 18 is a plan view indicating a relation between the jogging device and bins;

Fig. 19 is a side elevation of the jogging device;

Figs. 20 and 21 are plan views representative of a relation between bins and paper sheets;

Fig. 22 is a cross-section showing another specific configuration of a jogger shaft;

Figs. 23A and 23B are longitudinal sections each showing another specific configuration of the jogger shaft;

Fig. 24 is a side elevation showing another specific configuration of the jogger shaft;

Fig. 25 is a cross-section showing another specific configuration of the jogger shaft;

Fig. 26 shows the operation of the jogger shaft;

Fig. 27 shows how a bin is mounted;

Fig. 28 is a view showing how paper sheets are bent;

Figs. 29 and 30 are views for explaining different stacking conditions;

Fig. 31 is a front view of a bin;

Fig. 32 is a plan view of a bin;

Figs. 33 and 34 are views showing the significance of a pressing member;

Fig. 35 is a side elevation of a bin;

Figs. 36 and 37 are fragmentary sections each showing a rib;

Fig. 38 is a fragmentary side elevation of a bin;

Fig. 39 shows a positional relation between a discharge

roller and an upright wall;

Fig. 40 indicates how the trailing edges of paper sheets get on the upright wall;

Fig. 41 is a front view of a positioning roller device;

Fig. 42 is a front view of the positioning roller device;

Fig. 43 shows a relation between paper sheets and a positioning roller;

Fig. 44 is a front view showing a condition wherein th positioning roller devices are arranged;

Fig. 45 shows how the positioning roller positions a paper sheet;

Figs. 46, 47 and 48 show other specific configurations of the positioning roller;

Fig. 49 is a perspective view of a stapler device;

Fig. 50 is a plan view of the stapler device;

Fig. 51 is a front view of a bearing portion;

Fig. 52 is a view demonstrating the operation of the stapl r device;

Fig. 53 is a front view of a paper pulling device;

Figs. 54, 55 and 56 are front views representative of th operation of the paper pulling device;

Figs. 57 and 58 each shows a particular movement of a paper sheet on a bin;

Fig. 59 is a front view of a paper positioning mechanism;

Figs. 60 and 61 are front views showing the paper

positioning mechanism in operation;

Fig. 62 is a front view showing another specific construction of the paper positioning mechanism;

Fig. 63 is a perspective view showing another specific configuration of a bin fence;

Figs. 64 is a front view of the bin fence shown in Fig. 63;

Fig. 65 is a perspective view showing the operation of the bin fence of Fig. 63 in operation;

Fig. 66 is a plan view of the fin fence of Fig. 63;

Fig. 67 is a block diagram showing a specific construction of a control system particular to the illustrative embodiment;

Figs. 68A an 68B are flowcharts demonstrating the general operation of the embodiment;

Fig. 69 is a flowchart representative of a paper positioning sequence;

Fig. 70 shows the movement of the jogger shaft;

Fig. 71 is a flowchart showing a jogger shaft retracting procedure;

Figs. 72A to 72I are flowcharts showing a stapling procedure;

Fig. 73 is a flowchart showing a slow-up and slow-down procedure;

Fig. 74 is a perspective view showing another specific configuration of the paper pulling devic ; and

Fig. 75 is a view useful for understanding an advantage attainable with the configuration of Fig. 74.

To better understand the present invention, a brief reference will be made to conventional implementations for pulling a stack of paper sheets to a stapling position of a stapler.

Figs. 1 and 2 each shows a different prior art paper pulling device, particularly a stack of curled paper sheets and how such a stack is caught by chucks. In the figures, there are shown bins 350 of a sorter, an upper rotatable lever 622, a lower rotatable lever 624, an upper chuck 623, and a lower chuck 625. A stack of paper sheets is generally labeled P. Assume that the upper and lower chucks 623 and 625 rotate over a substantial angular range and over distances L_1 and L_2 which are substantially the same, as shown in Fig. 1. Then, when the chucks 623 and 625 chuck the upper paper stack P_1, the lower chuck 625 is apt to catch the lower paper stack P_2 which is curled. To eliminate this problem, it has been proposed to make the distance L_2 smaller than the distance L_1, as shown in Fig. 2. The relation $L_2 < L_1$ has customarily been set up by changing the gear teeth ratio and leverage of gears which drive the upper and lower levers 622 and 624. This scheme, however, is not practicable without complicating the construction and needing an extra space and, therefore, extra cost.

Fig. 3 schematically shows a traditional paper stack pulling device. There are shown in Fig. 3 a pulling member 615 and a stapler 701 having an opening 701a. The pulling m mber 615

moves into a notch formed in the bin 350, chucks a paper stack loaded on the bin 350, and then pulls the paper stack into the opening 701a of the stapler 701. At this instant, if the paper stack has been curled, it is likely that the pulling member 615 fails to surely chuck the whole paper stack and, therefore, to bring it into the opening 701a of the stapler 701. Fig. 4 shows a specific configuration of a conventional mechanism for pressing such a curled paper stack. In Fig. 4, each bin 350 is provided with a guide 702 for guiding a paper stack toward the opening 701a of the stapler 701. This kind of approach has a problem that the guides 702 have to be affixed to the bins one by one by time- and labor-consuming operations, resulting in the increase in cost. Moreover, the cost increases with the increase in the number of bins 350.

When the above-described type of paper pulling device is constructed to grip a paper stack with chucks at a single point of the stack, a moment is apt to act on the stack due to inertia in the event of pulling and to thereby cause the latter to skew. The skew would prevent the stapling position from being maintained constant.

The paper pulling device with the above construction is movable back and forth between a chucking position for chucking a paper stack on the bin 350 and a stapling position for stapling it. Such a movement of th device is implemented by a DC motor and a ball screw. However, th use of a DC motor is

disadvantageous for some reasons. Specifically, since the movement of the pulling device is effected by the start-up portions of the DC motor, it is difficult to control the rotation of the motor, i. e., to accelerate it constantly. Further, when the ball screw or similar load is not constant, the rotation of the DC motor itself fluctuates, rendering the control over the acceleration more difficult.

Referring to Fig. 5, a finisher embodying the present invention is shown which is free from the various drawbacks particular to the prior implementations as discussed above. As shown, the finisher has an inlet A for receiving copy sheets which are sequentially driven out of a copier or similar equipment. Inlet guides 101 and 102 are located at the inlet A while a selector in the form of a pawl 103 is located downstream of the inlet guides 101 and 102. An upper transport section 100 extends upward from the pawl 103 and includes, in addition to the inlet guide 101, guides 110 and 114, transport or drive rollers 108, driven rollers 109, a discharge or drive roller 111, a driven roller 115, and a proof tray 116. A skew section 200 extends downward from the pawl 103 and includes a skew guide 308, a driven guide 217, a guide plate 308, driven guide plates 308 and 309, an inlet roller 201, skew rollers 202, an outlet roller 203, driven rollers 214 and 216, and balls 215. The sk w s ction 200 t rminates at a deflecting section B via transport rollers 301 and 302 and driven rollers 305 and 306.

A deflecting pawl and a discharge roller 304 are associated with each bin 350 in the deflecting section B. Driven rollers 307 each is pressed against respective one of the discharge rollers 304 with the intermediary of a vertical transport path. A proof motor 117 drives the transport rollers 108 and outlet roller 111 while a drive motor 313 drives the inlet roller, screw rollers 202, outlet roller 203, transport rollers 301 and 302; and discharge rollers 304. A pulse generator 315 is provided in a driving section so as to generate pulses proportional in number to the rotations of the motor 313.

As shown in a plan view in Fig. 6, a stapler device 700 is located at one side of the group of bins 350 and has a stapler 701, a pulling device or chucking section 615 for pulling a paper stack to the stapler 701, and a mechanism for moving the stapler 701 and chucking section 615 up and down to the individual bins. A jogging device 500 is disposed at the other side of the group of bins 350 and has a jogger shaft 502 for positioning a paper sheet before a stapling operation, and an arrangement for moving the shaft 502 to a size matching a particular paper size. A positioning roller device 550 is positioned in close proximity to that side of the bin 350 where the stapler unit 700 is located.

As shown in Fig. 5, the finisher or sorter has twenty bins in total. A bin sensor 321 and a pap r sensor 322 are locat d in an upper portion of the sorter while a bin sensor 323 and a

paper sensor 324 are located in a lower portion of the same. The sensors 321 to 324 each is implemented as an optical sensor made up of an LED (Light Emitting Diode) and a phototransistor. The paper sensors 322 and 324 are responsive to the discharge of paper sheets, and the bin sensors 321 and 323 are responsive to the presence of paper sheets in the bins 350. A discharge sensor 125 is associated with the upper transport path 100 to see if paper sheets, or copy sheets, have been driven out onto the proof tray 116. An inlet sensor 314 is provided in the lower transport section 300 for implementing, for example, the timings at which paper sheets should be distributed to the individual bins 350. The sensors 115 and 314 each comprises a photointerrupter with an actuator.

Figs. 7 and 8A show the upper transport section 100 in detail in a front view and a side elevation, respectively. A paper sheet or copy sheet driven out of the copier body is guided by the guides 101 and 102 toward the pawl 103. The pawl 103 is connected to a solenoid (SOL) 107 by links 104, 105 and 106. When the solenoid 107 is turned off, the pawl 103 steers the paper sheet toward the skew section 200 located below the transport section 100. When the solenoid 107 is turned on, the pawl 103 feeds the paper sheet into the upper transport section 100.

Specifically, on the turn-on of the solenoid 107, the pawl 103 steers the pap r sheet toward the transport roller 108

disposed immediately above the pawl 103. The transport roller 108 is made of EPDM or chloroprene rubber. The driven roller 109 associated with the transport roller 108 is constantly pressed against the latter by a leaf spring or similar biasing member. Three pairs of such transport and driven rollers 108 and 109 are arranged along the upper transport path 100 to drive the paper sheet upward toward the proof tray 116 through between the guides 101 and 110.

The driven rollers 109 and pawl 103 are mounted on the guide 110. As shown in Fig. 8B, the guide 110 is hinged to the framework of the sorter by a pin 112 so that it may be opened to uncover the pawl 103 and driven rollers 109. This will promote easy work in the event of a paper jam or similar occurrence.

The paper sheet is guided by the guides 101 and 114 to reach the outlet roller 111 which is also made of EPDM or chloroprene rubber. The driven roller 115 is constantly pressed against the outlet roller 111 by a leaf spring or similar biasing member. The rollers 111 and 115 cooperate to drive the paper sheet onto the proof tray 116. As shown in Fig. 5, the proof tray 116 is located closer to the copier body, i.e., the operator than the bins 350. This not only allows the operator to see and pick up the copy sheets with ease but also reduces the paper transport distance and, therefore, transport time to the proof tray 116. If desired, the proof tray 116 may be implemented as a part of

an upper cover of the sorter.

Fig. 9 shows a drive mechanism associated with the upper transport section 100. As shown, the upper transport section 100 has an exclusive motor 117. The rotation of the motor 117 is transmitted to the transport rollers 108 and outlet roller 111 via gears 130 and 131, a timing belt 118, and timing pulleys 119 and 120. The timing pulleys 119 and 120 are affixed respectively to the shafts of the transport rollers 108 and outlet roller 111.

It is noteworthy that the upper transport section 100 does not have any transport roller between the pawl 103 and the output of the copier body. In such a configuration, in an operation mode which uses the proof tray 116, a copy sheet is transported with only the motor 100 of the upper transport section 100 and the solenoid 107 being operated. On the other hand, in an operation mode which uses the bins 350, the drive motor 117 and solenoid 107 do not have to be powered. This is desirable from the efficient power supply standpoint. In addition, the two fully independent transport paths promote easy jam recovery, for example.

The upper transport section 100 is constructed into a unit and is easy to remove. Fig. 10 shows another specific configuration of the upper transport section 100, i. e., a unit U having an inlet A_1. It will be seen that the finisher is usable with a copier body having an outlet at a differ nt level only if the unit

U is replaced with another. In Fig. 10, the same components as those shown in Fig. 5 are designated by the same reference numerals.

Referring again to Fig. 5, the skew section 200 is a unit for changing, when a paper sheet is driven out of the copier body with the center thereof being used as a reference, the reference to the front edge of the paper sheet within the transport path. The skew section 200 is situated in the vertical portion below the pawl 103. Using the vertical portion is successful in reducing the overall size of the sorter.

In a sort or stack mode which uses the bins 350, the paper sheet or copy copy sheet fed from the copier body is steered by the pawl 103 toward the inlet roller 201 of the skew section 200. The inlet roller 201 is made of EPDM or chloroprene rubber. The driven roller 214 is constantly pressed against the inlet roller 201 by a leaf spring or similar biasing member.

Fig. 11 shows a part of the skew section 200 where the skew rollers 202 are positioned. As shown, the two skew rollers 202 each is inclined by about 25 to 30 degrees such that the paper sheet is directed toward a reference guide 204. The skew rollers 202 are also made of EPDM or chloroprene rubber. As shown in Fig. 12, the driven rollers 215 associated with the skew rollers 202 each is implemented with a ball 215 which is biased by a compression spring 218. Such a configuration increases th freedom regarding the rotating direction of a paper sheet and,

when the copy sheets abuts against the reference guide 204, prevents it from being bent or otherwise deformed. The paper sheet driven askew into abutment against the reference guide 204 reaches the outlet roller 203. The outlet roller 203 is made of the same material as the inlet roller 201 and insures the transport of the paper sheet to the following transport path. In Fig. 12, a case 219, a pressing member 220 and the compression spring 218 cooperate to press the ball 215 in the vertical transport path. The rotation speed V_1 of the inlet roller 201 is nearly equal to the rotation speed V_2 of the skew rollers 202 which is in turn lower than the rotation speed V_3 of the outlet roller 203. It is to be noted that since the rotation speed V_2 of the skew rollers 202 is a downward transport component, it is selected to be $V_{20} \times \cos\theta$. In illustrative embodiment, the speed V_2 is $V_3 \cos\theta$ because V_{20} is equal to V_3. Further, the transporting force F_1 of the inlet roller 201 is greater than the transporting force F_2 of the skew rollers 202 which is in turn nearly equal to the transporting force F_3 of the outlet roller 203. Providing only the inlet roller 201 with such a great transporting force F_1 is advantageous in that after the leading edge of a paper sheet has reached the skew rollers 202, the sheet is prevented from being driven askew until the leading edge thereof moves away from the inlet roller 201, whereby the skew timing is maintained constant. The transporting force F_3 of the outlet roller 203 which is selected to be equal to the transporting force

F_2 of the skew rollers 202 insures some margin regarding the skew transport distance.

Fig. 13 shows a drive system associated with the skew section 200. In Figs. 11 and 13, a driving force is applied to a timing pulley 210 which is affixed to the shaft of the outlet roller 203. The timing pulley 210 transmits the driving force to the inlet roller 201 via a timing pulley 206 and a double-tooth timing belt 213. The timing pulley 206 is rigidly mounted on the shaft of the inlet roller 201. Fig. 14 shows a drive transmitting portion in an enlarged front view. As shown in Figs. 11 and 14, since each skew roller 202 has to have the shaft thereof inclined, it is driven by the timing belt 213 via an idler 208 which has a helical gear 208a and a timing pulley 208a. Fig. 15 shows the skew motion of a copy sheet schematically. As shown, a paper sheet P begins moving askew as soon as its trailing edge moves away from the inlet roller 201, ends the skew motion when its end abuts against the reference guide 204, and then moves straight ahead under the action of the outlet roller 203.

The reference guide 204 is shown in a fragmentary section in Fig. 16. In the illustrative embodiment, the reference guide 201 is fastened by screws to a drive guide 205 which faces a driven guide 217.

The paper sheet moved away from the skew section 200 is guided by the transport guide 308 and driven guides 309 and 310 and driven by the transport roller 301 and driven rollers 305 and 306 to the deflecting section B. The deflecting section B has the discharge roller 304, driven roller 307, driven guide plate 311, and pawls 312. The pawls 312 each is actuated by a solenoid, i. e., it is opened or closed by a solenoid on the basis of a designated mode to stack copy sheets in the associated bin 350.

The jogging unit will be described with reference to Figs. 17 to 19. As shown, a bin fence 450 extends upright from one side edge of each bin 350 while an upright wall 508 extends from another side edge of the bin 350 which is perpendicular to the edge where the bin fence 450 is positioned. An elongate slot 511 is formed through the bin 350 in close proximity to the edge opposite to the edge where the bin fence 450 is positioned. As shown in Fig. 18, the elongate slot 511 extends toward the bin fence 450 over a predetermined distance. The distance *a* of the slot 511 to the upright wall 508 is smaller than the sum of the distance *b* b twe n the bin fence 450 and the upright wall 508 and th width *c* of the fin fence 450. In the illustrative

embodiment, the distance a lies in the range of 125 to 140 millimeters which was found to be favorable by experiments. Specifically, should the dimension a be smaller than 124 millimeters, a moment would act on a paper sheet P of relatively large format such as A3, as shown in Fig. 20. Conversely, should the dimension a be greater than 140 millimeters, a moment would act on a paper sheet P of relatively small format such as B5 and fed in a laterally long position, as shown in Fig. 21. Such moments prevented paper sheets from being positioned in an expected panner.

In Figs. 17 to 19, the shaft jogger 502 extends upright throughout the slots 511 of the individual bins 350 and functions to position paper sheets by abutting against their edge. The jogger shaft 502 is provided with a high friction surface by rubber, sponge, sand paper, sand blasing or similar technology, as will be described. As shown in fig. 19,. the jogger shaft 502 is constantly biased by leaf springs 503a and 503b so as to free a paper stack from excessive forces, free individual copy sheets from scratches and creases, and free the motor from overloads. Figs. 22 to 25 each shows a specific implementation for providing the shaft 502 with a high friction surface. In Fig. 22, rubber, cork, sponge or sandpaper serving as a high friction membeer H is adhered to at least a part of the surface of the shaft 502 which contacts copy sheets. In Fig. 23A, the high friction member H is implemented as

horizontally projecting bristles while, in Fig. 23A, it is implemented as downwardly projecting bristles. In Fig. 24, the surface of the shaft 502 is treated by sand blasting to implement the high friction member H. Further, in Fig. 25, the high friction member H comprises powder or particles deposited on the surface of the shaft 502.

Fig. 26 shows the interaction of the jogger 502 and the copy sheet P. As the shaft 502 moves to shift the paper sheet P from a position (1) toward a position (2), the high friction member H causes the sheet P to move in a direction X without slipping on the shaft 502 even through the sheet P may have been curled. The paper sheet P, therefore, surely reaches the bin fence 450 and is positioned by the latter with accuracy. To further promote accurate positioning of the paper sheet P, an arrangement may be made such that the shaft 502 moves downward while urging the sheet P in the direction X. This will be successful in correcting the deformation (curl) of the paper sheet P forcibly. In such a configuration, the shaft 502 may be provided with a member rotatable up and down to press a curled portion of the paper sheet.

As shown in Figs. 17 and 19, the upper and lower ends of the jogger shaft 502 are nested in recesses of holders 504a and 504b, respectively. Timing belts 507a and 507b are respectively located above and below the bins 350 and extend in substantially the same direction as the slots 511 of the bins 350. Lugs

provided on the holders 504a and 504b are respectively mated with recesses formed in the timing belts 507a and 507b, whereby the holders 504a and 504b are affixed to the associated timing belts 507a and 507b. Among pulleys 509, 510, 516 and 512 over which the timing belts 507a and 507b are passed, the pulleys 509 and 516 are respectively affixed to opposite ends of a vertically extending drive shaft 514. The lower timing belt 507b is passed over a pulley 512 which is rigidly mounted on the output shaft of a size shift motor 515. The displacement of the jogger shaft 502 based on size is supervised in terms of the number of pulses to be applied to the size shift motor 515.

Specifically, for a certain paper size, the size shift motor 515 drives the jogger shaft 502 to a position spaced apart by a predetermined distance from a paper sheet which will arrive (in the embodiment, 10 millimeters; hereinafter referred to as a first stop position). As soon as such a paper sheet fully enters the bin 350 and drops onto the upright wall 508, the jogger shaft 502 is moved toward the sheet and then brought to a stop when moved beyond the edge of the sheet by a predetermined amount (in the embodiment, 5 millimeters; hereinafter referred to as a second stop position). When the shaft 502 is to b returned after positioning a copy sheet, it may be once brought to a stop at the width corresponding to the paper size (hereinafter referred to a third position) and then moved to its original position. Alternatively, the moving spe d of the shaft

502 may be varied during the course of the return. This is to prevent the copy sheet once positioned on the bin 350 from moving away from the bin fence 450 due to its own elasticity. In the illustrative embodiment, the jogger shaft 502 moves from the second stop position to the third stop position at a speed lower than a speed at which the paper sheet urged against the bin fence 450 springs back due to the elasticity thereof. As a result, the position of the paper sheet on the bin 350 is prevented from being disturbed due to spring-back or similar cause.

A reflection type sensor, not shown, is mounted on the holder 504a in a position closer to the bin fence 250 than to the shaft 502. After the jogger shaft 502 has positioned the first copy sheet on the bin 350, it is moved by the size shift motor 515 with the above-mentioned sensor searching for the edge of the copy sheet. Since the size shift motor 515 is implemented with a stepping motor, it is possible to find the position of the edge of the copy sheet by counting pulses from the instant when the motor 515 has begun to rotate to the instant when the sensor turns on. Hence, the third position of the jogger shaft 502 can be determined accurately even if the paper size is irregular (in the range of 1 to 2 millimeters). Alternatively, the third position may be simply calculated by use of a paper size signal transmitted from th copier body so as to move the shaft 502 accordingly.

While the paper positioning arrangement has been shown and described in relation to the bin 350, it is similarly applicable to a conventional tray to be loaded with copy sheets. A paper stack is urged against the bin fence 450 and thereby positioned at one edge thereof. Regarding another edge perpendicular to that edge, the paper stack is abutted against the upright wall 508 which is perpendicular to the bin fence 450, by using the inclination of the bin 350.

Each bin 350 is provided with various kinds of devices for promoting accurate and efficient paper positioning and stapling, as follows.

Fig. 27 shows the bin 350 in a position mounted on the sorter. As shown, the bin 350 has a main angular portion 401 and auxiliary angular portions 402 and 403 which are smaller in inclination than the main angular portion 401. When the main angular portion 401 is provided with a certain angle (in the illustrative embodiment, 30 degrees), a paper stack begins to bend as the number of paper sheets increases. This is especially true when the individual paper sheets are thin (see portion A, Fig. 28). To prevent this, the auxiliary angular portion 403 bears a part of the weight of the paper stack. In this embodiment, the angle of the auxiliary angular portion 403 is selected to be 15 degrees. However, should the main angular portion 401 be excessively short and the auxiliary angular portion 403 be excessively long, th auxiliary portion 403 would

bear an excessive part of the weight of the paper stack to thereby prevent the stack from falling along the bin 350. Preferably, the main angular portion and the auxiliary angular portion are dimensioned about 300 millimeters and about 80 millimeters, respectively.

The auxiliary angular portion 402 is a countermeasure against face curl. Fig. 29 shows a bin 350 without the auxiliary angular portion 402 and paper sheets with face curl stack on such a bin 350, while Fig. 30 shows a bin 350 with the auxiliary angular portion 402 and paper sheets with face curl stacked thereon. In Fig. 29, the paper stack P is spaced apart from the bin 350 in a portion *c* while, in Fig. 30, the clearance between the paper stack P and the bin 350 is not noticeable in a portion *d*. This indicates that the configuration shown in Fig. 30 allows a greater number of paper sheets with face curl to be stacked together than the configuration shown in Fig. 29. In the illustrative embodiment, the auxiliary angular portion 402 has an angle of 15 degrees and a length of about 20 millimeters.

Referring to Figs. 31 and 32, a projection 411 extends downward from the underside of the bin 350 for the purpose of pressing the curl of a paper sheet. Although a paper sheet driven out onto the bin 350 is positioned in one direction, it is apt to get over the fence 450 when its curl is great. The projection 411 presses such a curl of the paper sheet to promote accurate positioning. Figs. 33 and 34 show a bin 350 with the

projection 411 and a bin 350 without the projection 411, respectively. In Figs. 33 and 34, a paper sheet sequentially assumes positions (1), (2) and (3). In Fig. 32, the reference numerals 412, 413 and 414 designate projections for fixing the bin 350 in place.

Fig. 35 shows the bin 350 in a mounted position. In the figure, there are shown side panels 430a and 430b and bin supports 431a and 431b. The bin 350 is fixed in place by the bin support 430a located at the bin fence side F and is simply held on the other bin support 431b while being slightly spaced apart from the latter. Fixing the bin 350 at the bin fence side F maintains the stapling position constant. The small clearance between the bin 350 and the bin support 431b successfuly absorbs thermal expansion of the bin 350.

As shown in Fig. 32, the bin 350 is provided with a bin rib 415a for allowing a paper sheet to fall smoothly. Bin ribs 415b, 415c and 415e also provided on the bin 350 are higher than the other ribs in their portions close to the notch which is adapted to take out a paper stack, whereby a paper stack is prevented from bending when loaded on the bin 350. The bend of a paper stack would obstruct smooth fall of the stack. When a paper sheet is positioned by the jogger shaft 502 in a bent position, it often fails to be positioned with accuracy since it lacks elasticity. Ribs 415f ar so configured as to prevent a paper sheet from entering the slot 511. Specifically, as shown in Fig. 36, th ribs 415f

each protrudes upward and downward in the vicinity of the slot 511 to prevent a paper sheet from entering the sót 511 and to prevent it from entering the not of the overlying bin. The ribs 415f are arranged in a position substantially 10 millimeters inward of the edge of the paper size so as to surely guide the edges of those paper sheets which are apt to enter the slot 511. Each rib 415f extending upward from the bin 350 has a triangular configuration which is less inclined at one side than at the other side. With such a configuration, the ribs 415f guide a stapled paper stack P so that the latter may be discharged without being caught by the former. As shown in Fig. 37, the ribs 415f each is configured as comparatively low ribs 415f and 415h in the vicinity of the upright wall 508 of the bin 350, Fig. 31, and is sequentially increased in height toward the slot 511 for the purpose of accommodating a greater number of paper sheets. Bin ribs 415g are aligned with the ribs 415f and adapted to promote smooth fall of paper sheets.

In Fig. 32, the bin 350 is formed with a notch 416 to allow the chuck section to chuck a stack of paper sheets positioned on the bin 350. A portion 417 of the bin 350 is positioned at a lower level than the other part of the bin 350, as best shown in Fig. 38. This portion 417 facilitates the removal of a paper stack of relatively small size. Should the notch 422 be extended deeper into the bin 350 in order to omit the portion 417, the mechanical strength of the bin 350 would be critically lowered.

In Fig. 32, the reference numeral 418 designates notches for accommodating a discharge roller.

Fig. 39 shows a positional relation between the discharge roller 304 and the upright wall 508 of the bin 350. The angle *a* shown in the figure is slightly greater than 90 degrees. A portion *b* is straight while a portion *c* is curved. The dicharge roller 304 protrudes beyond the portion *c* in the paper discharging direction. The configuration of the upright wall 508 shown in Fig. 39 is effective regarding the positioning accuracy when paper sheets have face curl. However, when more than a certain number of paper sheets with face curl are stacked on the bin 350, the stack P becomes higher than the upright wall 508 with the result that an upper part thereof rides on the wall 508, as indicated by X in Fig. 40. In the illustrative embodiment, the unique configuration of the wall 508 and the unique position of the discharge roller 304 mentioned above are combined to enhance accurate positioning of paper sheets with face curl. In addition, the discharge roller 304 urges the paper sheets downward to eliminate the occurrence shown in Fig. 40. A rib 419 shown in Fig. 31 and a rib 421 shown in Fig. 32 reinforce the bin 350.

Figs. 41 and 42 show a positioning roller assembly 550 which promotes more accurate paper positioning with no regard to the kind of paper sheets. As shown, the assembly 550 has a positioning roller 333 mounted on a driven shaft 332 which is in turn retained by a roll r holder 331. The roller holder 331 is mount d on a shaft 340 together with the discharge roller 304.

A drive pulley 334 is affixed to the discharge roller 304. The positioning roller 333 is driven by the drive pulley 334 in interlocked relation to a driven pulley 335 affixed to the driven shaft 332 by a belt 336. The drive pulley 334 and driven pulley 335 have an inclination of about 10 degrees. The positioning roller 333 shifts a paper sheet obliquely and thereby positions it against both of the bin fence 450 and upright wall 508.

Fig. 43 indicates a positional relation between the positioning roller 333 and a paper sheet P. A paper sheet P transported by the discharge roller 304 and driven roller 307 is fed into the bin 350 through the associated pawl 312. At this instant, the positioning roller 333 is spaced apart from the bin 350 by 5 to 7 millimeters, so that the paper sheet P moves above the roller 333 into the bin 350 (position (1)). The rear edge of the paper sheet P jumps out over the upright wall 508 by 20 to 30 millimeters due to the speed at which the sheet P is driven into the bin 350. The center of the positioning roller 333 is spaced apart by about 15 millimeters from the upright wall 508 and by about 20 millimeters from the bin fence 450. A paper sheet P dropped on the positioning roller 333 is forced to drop by the roller 333 onto the bin 350. The paper sheet P thus laid flat on the bin 350 by the roller 333 is shifted toward the wall 508 due to the inclination of the bin 350 and, as a result, gets under the roller 333 (position (2)). Thereafter, when the rear edge of the paper sheet P contacts or is about to contact the wall 508,

the jogger shaft 502 is moved to cause the sheet P into abutment against the bin fence 450, as stated earlier. Subsequently, as shown in Fig. 44, a solenoid 342 is energized to raise a bracket 337. As a result, a pin 339 received in a hole 338, Fig. 41, is raised to cause the roller holder 331 to rotate counterclockwise about the shaft 340, whereby the positioning roller 333 is let fall onto the bin 350. In this condition, the roller 333 in rotation urges the paper sheet P against the wall 508 and bin fence 450. The movement of the shaft 502 and that of the positioning roller 333 described above are completed before the next paper sheet arrives at the bin 350 or before it reaches the position between the roller 33 and the bin 350. The second and successive paper sheets are positioned in the same manner as the first sheet. If the force exerted by the positioning roller 33 on a paper sheet P for the positioning purpose is excessively great, the paper sheet will be bent, as shown in Fig. 45. In the light of this, the transporting force of the positioning roller 333 is selected such that the roller 333 transports a single paper sheet P and, on abutment of the sheet P against the bin fence 450 and wall 508, simply slips on the sheet P. Specifically, as shown in Fig. 46, the positioning roller 333 has a high friction member 333b which protrudes from a part of a low friction member 333a. Alternatively, a plurality of high friction members 333b may be provided on th positioning roller 333, as shown in fig. 47 or 48. If desired, a member having an adequat degree of friction

may be provided on the positioning roller 333 in order to achieve the same advantage.

A stack of paper sheets positioned by the above sequence of steps is stapled or otherwise finished and then taken out in a direction indicated by an arrow x in Fig. 18. The removal of the finished paper stack is easy because no obstruction exists in the direction x.

Referring to Figs. 49, 50 and 51, the stapler device 700 located at one side of the bins 350 has a flat bracket 703 which is loaded with the stapler 701 and paper pulling device 615. The stapler 701 sequentially drives staples into paper sheets distributed to and stacked on the individual bins, while the paper pulling device 615 chucks such paper stacks one at a time and carries them substantially in the horizontal direction. One end of the bracket 703 is bent upward, and a bracket 703a is affixed to that end of the bracket 703. A bearing 704 shown in Figs. 50 and 51 is mounted on the bracket 703a and affixed to the latter by a stop ring 705. A shaft 710 is retained by holders 708 and 709 which are mounted on a base 706 and an upper panel 707, respectively. The bearing 704 is slidably coupled over the shaft 710. Rollers 714 and 715 are respectively mounted on shafts 712 and 713 which are in turn mounted on the bracket 711. The rollers 714 and 715 hold a bracket 716 therebetween.

A driv belt 717 extends upward and substantially parallel to

the side edges of the bins 350. The drive belt 717 is held between and fastened to the bracket 703a and a bracket 718 by screws and passed over pulleys 719a and 719b which are spaced apart by a predetermined distance in the vertical direction. The rotation of a drive motor 720 is transmitted to a pulley 723 by a pulley 721 mounted on the output shaft of the motor 720 and a belt 22. A drive gear 724 is mounted on the same shaft as the pulley 723 while a gear 725 is held in mesh with the drive gear 724. Hence, the rotation of the pulley 723 is transmitted to the drive pulley 719a by way of the drive gear 724 and gear 725. The drive pulley 719a is mounted on one end of a shaft 726. By such a gearing, the drive belt 717 is driven in a rotary motion to move the stapler 701 and paper pulling device 615 up and down. A position sensor 727 is provided on the bracket 711 in such a manner as to hold it therebetween. The bracket 716 has holes 716a at equally spaced positions thereof which correspond to the bins 350. This position sensing mechanism causes the stapler 701 and paper pulling device 615 to be so controlled as to stop at the positions where the individual bins 350 are located. Further, a lug 728 and a sensor 729, Fig. 49, cooperate to define the upper limit position of the bracket 703. Specifically, when the lug 728 enters the sensor 729, the motor 720 is deenergized.

The operations of the stapler device 700 will b better und rstood with ref renc to Fig. 52 which schematically shows

a paper sheet P laid on the bin 350, the chuck section 620, and stapler 701. Specifically, the paper sheet P just entered the bin 350 is located in a position 730d and then brought into abutment against the bin 450 by the previously stated jogging device. After the copying operation has been completed, the chuck section 620 advances from a position 620b to a position 620c both of which are indicated by dash-and-dot lines in the figure. At the position 620c, the chuck section 620 closes to chuck the paper stack P and then stops at a position 620a as indicated by a solid line in the figure. As a result, the paper stack is shifted to a position 730f and stapled by the stapler 701 on the bin 350. Thereafter, the stapled paper stack P is returned to a position 730e by a sequence of steps opposite to the above-stated sequence. Then, the stapler unit 700 is moved to the next bin 350 to repeat such a stapling operation. The stapling operation outlined above will be described in detail later.

Referring to Figs. 53 to 56, the paper pulling device 615 has a chuck section 620 and a mechanism 640 for causing the chuck section 620 to move back and forth substantially in the horizontal direction. The chuck section 620 has an upper and a lower lever 622 and 624 which are rotatably mounted on a bas plate 621. A solenoid 626 actuates the upper and lower levers 622 and 624 to cause an upper and a lower chuck 623 and 625 to chuck a paper stack P.

The reciprocating mechanism 640 has a frame 641 and a

shaft 642 on and along which the chuck section 620 is slidable. Specifically, a bearing 629 carries the base plate 621 therewith and is slidably mounted on the shaft 642. A timing belt 643 is provided on the frame 641 for moving the chuck section 620 toward and away from the paper stack P. The chuck section 620 and timing belt 643 are affixed to an arm 621a extending out from the base plate 621. The timing belt 643 is passed over pulleys 644 and 645. The pulley 644 is mounted on the output shaft of a stepping motor 646. In this condition, the pulley 644 is rotated by the output of the stepping motor 646 to in turn move the timing belt 643. Then, the timing belt 643 causes the chuck section 620 affixed thereby through the arm 621a to move in a reciprocating motion. A position sensor 650 is provided on the frame 641 while a plate 630 is provided on the base plate 621 to be sensed by the sensor 650. The position sensor 650 is responsive to the home position of the chuck section 620. It is to be noted that the home position of the chuck section 620 intervenes between a chucking position on the bin 350 and a stapling position.

In operation, on the start of a staple mode operation, the drive belt 717, Fig. 49, moves the stapler 701 and paper pulling device 615 up or down. Specifically, as shown in Fig. 53, the stapler 701 and paper pulling device 615 are moved toward one of the bins 350 which is loaded with a paper stack P to be stapled. The stapler 701 and paper pulling devic 615 are

brought to a stop in the vicinity of the bin 350 of interest on the basis of the output of the position sensor 727, Fig. 49. At this instant, the solenoid 626 is not energized so that the rotatable levers 622 and 624 and, therefore, the chucks 623 and 625 are held in their open position.

Thereafter, the stepping motor 646 is rotated by a predetermined amount to move the timing belt 643 and to thereby move the chuck section 620 toward the paper stack P. The moving speed of the chuck section 620 is controlled by varying the rotation speed of the stepping motor 646. In the illustrative embodiment, when the chuck section 620 having chucked the paper stack P returns to the stapling position, it is sequentially accelerated at the beginning of such a movement and then sequentially decelerated at the end of the same in order to prevent the accurately position paper stack P from being disturbed due to inertia. In this embodiment, the chuck section 620 is accelerated and decelerated on a nearly constant acceleration basis since the maximum inertia of a constant acceleration motion is smallest.

As soon as the chucks 623 and 625 reach a position where they can chuck the paper stack P (Fig. 55), they are stopped there and, at the same time, the solenoid 626 is energized. As a result, the chucks 623 and 625 are closed (Fig. 54) to chuck an edge portion of the paper stack P. More specifically, when the solenoid 626 is turned on, a spring 627 anchored to the

solenoid 626 pulls a lever 628 to which the upper lever 622 is connected. As a result, the upper lever 622 is rotated counterclockwise about a fulcrum 622a to in turn lower the upper chuck 623. The lower lever 624 contacts the upper lever 622 at a potion 624c thereof, so that the movement of the upper lever 622 is transmitted to the lower lever 624. The lower lever 624 is, therefore, rotated clockwise about a shaft 624a to raise the lower chuck 625. Consequently, the upper and lower chucks 623 and 625 chuck the paper stack P. The displacement of each of the chucks 623 and 625 is determined by the distances between the fulcrum of rotation of the lever 628 and the points of force and action. In the illustrative embodiment, as shown in Fig. 54, the upper chuck 623 is assume to have a fulcrum 622a which is spaced apart by 92 millimeters from a point of action 622b and by 33 millimeters from a point of force 622c. Hence, the displacement of the chuck 623 is 92 : 33 which is nearly equal to 2.79 : 1 in terms of ratio. Regarding the lower chuck 625, the shaft 624a is assumed to be spaced apart by 26 millimeters from a point of action 624b and by 33 millimeters from a point of force 624c, so that the displacement is 26 : 33 which is nearly equal to 0.79 : 1 in terms of ratio. More specifically, when the upper chuck 623 moves downward by 3.5, the lower chuck 623 moves upward by 1. Further, the chucking force of the chucks 623 and 625 is determined by the force of the spring 627 anchored to the solenoid 626. As the number of

paper sheets P to be chucked by the chucks 623 and 625 increases, the spring 627 becomes longer and, therefore, the chucking force becomes stronger. This frees the paper sheets P from dislocation ascribable to weak chucking force.

When the chucks 623 and 625 are constructed to grip one point of the paper stack P adjacent to a corner, a moment acts on the paper stack P due to inertia in the event when the paper stack P is pulled, as shown in Fig. 57. Then, the paper stack P will be shifted askew on the bin 350 and thereby stapled in an unexpected position. To eliminate this problem, as shown in Fig. 58, the chucks 623 and 625 may each be bifurcated or otherwise configured to grip the paper stack P at a plurality of points of the latter.

Subsequently, the stepping motor 646 is reversed to cause the chuck section 620 to return to the original position while carrying the paper stack P therewith, as shown in Fig. 56. As a result, the paper stack P is shifted in the substantially horizontal direction toward the stapler 701. As soon as an edge portion of the paper stack reaches a position where it can be stapled, the chuck section 620 is brought to a halt. Thereafter, the stapler 701 is actuated to drive a staple into the edge portion of the paper stack P.

On completion of the stapling operation, the stepping motor 646 is rotated in the forward direction to advance the chuck 620 away from the stapler 701. After the chuck section 620 has returned the paper stack P to the bin 350, the solenoid 626 is deenergized with the result that the upper and lower chucks 623 and 625 are open d. Th stepping motor 646 is reversed again to move the chuck section 620 back to the predetermin d

position. Then, the stapler 701 and paper pulling device 615 are moved downward toward the next bin for repeating the above stapling operation there.

Referring to Figs. 59 to 61, the paper positioning mechanism will be described more specifically. As shown in Fig. 59, the bin fence 450 extends upward from the edge of the bin 350 which is adjacent to the stapler 701. The bin fence 450 is rotatably mounted on a shaft 451 which extends along the underside of the bin 350. Hence, the bin fence 450 is tiltable to an open position, as shown in Fig. 60. The shaft 451 is journalled to the bin 350 by bearing portions 456 which extend downward from opposite edge portions of the bins 350. A helical spring 452 is wound round the shaft 451 and anchored at opposite ends thereof to the back o the bin fence 450 and the underside of the bin 350. In this configuration, the bin fence 450 is constantly biased by the spring 452 to the upright position thereof.

The bin fence 450 is openable in interlocked relation to the upward and downward movement of the stapler 701. A fence rotating plate 453 provided on the shaft 451 and a fence releasing plate 454 provided on the stapler 701 constitute members for so tilting the bin fence 450. The fence rotating plate 453 is partly received in a sectoral opening formed through one extension 450a of the bin fence. When the plat 453 is rotated downward, the lower edge of the sectoral opening of the

bin fence 450 abuts against the plate 453 with the result that the bin fence 450 is tilted along with the plate 453. When the plate 453 is rotated upward, it does not contact the bin fence 450 and is free to rotate. A roller 454a mounted on the fence releasing plate 454 protrudes to remain in contact with the fence rotating plate 453. When the stapler 701 is elevated or lowered, the roller 454a rotates the plate 453 in contact therewith.

While a sorting operation is under way, the bin fence 450 is held in the upright position by the helical spring 452, as shown in Fig. 59. In this condition, the paper sheets P entering the bin 350 one after another are positioned with their edges abutting against the bin fence 450. When the sorting operation is completed, the stapler 701 begins to move downward with the result that the roller 454a provided on the stapler 701 contacts the fence rotating plate 453 of the bin 350 and urges the latter downward, as shown in Fig. 60. The plate 453 in turn causes the bin fence 450 to tilt against the action of the helical spring 452, whereby the bin fence 450 is opened. At this instant, the bin fence 450 and plate 453 have been lowered beyond the major surface or plane A of the bin 350. In this condition, the previously stated stapling operation is effected.

When the stapled sheet stack P is returned to the original position on the bin 350, the stapler 701 is lowered toward the next bin 350. As the fence releasing plate 454 is moved away from the fence rotating plate 453 due to the downward

movement of the stapler 701, the bin fence 450 is raised to the original position by the spring 452. The movement of the bin 350 and the stapling operation described above occur in all of the bins 350 to which paper sheets P have been distributed.

After all the paper stacks P have been stapled, the stapler 701 is elevated to the uppermost position, i. e. a home position which is higher in level than the first or uppermost bin 350. At this time, although the fence releasing plate 454 contacts the fence rotating plate 453 from below, the plate 453 simply idles upward without rotating the bin fence 450, as shown in Fig. 61. As soon as the plate 454 moves away from the plate 453 due to the elevation of the stapler 701, the plate 453 is returned to th position shown in Fig. 59 due to gravity.

Fig. 62 shows a modification of the paper positioning mechanism described above. As shown, an elastic member 455 is affixed to the bin fence 450 for the purpose of receiving the fence rotating plate 453. When the plate 453 is idly rotated upward by the returning stapler 701, it abuts against the elastic member 455. As a result, the plate 453 is returned to the original position by the elasticity of the member 455.

Referring to Figs. 63 to 66, another specific configuration of the bin fence 450 will be described. As shown in Figs. 63 and 64, the bin fence 450 is implemented as a single fence 460 which abuts against all of the bins 350 for positioning paper sheets. Specifically, the fence 460 is rotatable about an upper and a

lower fulcrums 460a and 460b and has a gear 460c at the lower fulcrum 460b. The gear 460c is in mesh with a gear 461 which is driven by a motor 462. To position paper sheets, the fence 460 is brought to the position shown in Figs. 63 and 64 where it faces the bins 350. During a stapling operation which follows a sorting operation, the fence 450 is rotated by 90 degrees from the position of Figs. 63 and 64 to the position of Figs. 65 and 66. In such a position, a paper stack P can be shifted to the stapling position.

Fig. 67 shows a control system applicable to the illustrative embodiment. As shown, the control system is implemented as a microcomputer control system having a CPU 800, a ROM 801, a RAM 802, I/O ports 803 and 806, a clock timer controller (CTC) 804, and a universal asynchronous receiver transceiver (UART) 805. By using a program stored in the ROM 801 and RAM 802, the CPU 800 receives output signals of sensor switches (SW) via the I/O port 806 and controls various loads via various drivers 808, 809, 810, 811 and 812, a phase signal generator 813 and a SSR 807 in response to the outputs of the I/O port 803 and CTC 804. The control system is connected to the copier by an optical fiber, not shown, via the driver 815 and UART 805 so as to interchange various status and command signals.

Specifically, the sensors and switches (input system) include the inlet sensor 314, outlet sensor 115, bin s nsors 321 and

323, discharge sensors 322 and 324, pulse generator 315, cover SW, DIPSW, size home sensor 501, elevation home sensor 729, elevation position sensor 727, chuck home sensor 650, stylus sensor, paper sensor 675, and staple home sensor. The loads (output system) include the sorter motor (AC motor) 313, switching SOL 107, deflecting SOLs, chuck SOLs 626, positioning SOLs 342, proof motor (DC motor) 117, staple motor (DC motor), size shift motor (stepping motor) 515, elevation motor (stepping motor), an chuck motor (stepping motor) 646.

Among the signals interchanged between the control system and the copier, signals sent from the copier and meant for the stapler unit 700 include a sorter start signal, copier paper discharge signal, staple end signal, system reset signal, service call reset signal (S. C reset), status request signal, mode signal, size signal, and bin designate signal. Signals sent from the stapler 700 to the copier include a type identification signal, paper-on-tray signal, stack over signal, bin over signal, cover open signal, no stylus signal, JAM signal, staple inhibit signal, paper discharge signal, WAIT signal, BUSY signal, end-of-mode signal, staple count signal, and error signal.

Figs. 68A and 68B are flowcharts demonstrating the overall operation of the illustrative embodiment. As shown, the control system receives a mode signal from the copier (step S1-1). After the start of a copying operation, the system r ceives a size signal (S1-2) and th n a sorter start signal (S1-3). In

response, either the sort motor (for sorting or stacking) or the proof motor (for proof or interrupt) is turned on as indicated by the mode signal. The proof mode (S1-4) will be described first.

After the proof motor 117, Fig. 5, has been turned on (S1-5), the switching SOL 107, Fig. 7, is energized (S1-6). On receiving a paper discharge signal (S1-7), the control system steers a paper sheet come in through the inlet guide 102 (S1-8) toward the proof tray 116 (S1-9). After the discharge of the paper sheet onto the proof tray 116, a paper discharge signal is sent to the copier (S1-10) to inform the copier of the discharge of the received paper sheet. The steps described so far are repeated until the copying operation ends (S1-11). Of course, the control system is performing jam detection, although not shown. When the copying operation is completed, the switching SOL 107 and proof motor 117 are turned off (S1-12). Then, the system awaits the next copying operation.

The sort or stack mode operation is as follows. After the sorter motor 313, Fig. 5, has been turned on (S1-13), whether or not jogging is allowable is determined on the basis of the size signal, for example. If the answer of the decision is positive (YES) (S1-14), the jogger shaft 502 is shifted to a position matching the size signal (S1-15). When the copier drives a paper sheet thereoutof, it sends a bin designate signal and a discharge signal to the control system (S1-16). A bin 350 of

interest is decided on the reception of the discharge signal (S1-17). Then, a paper sheet from the copier enters the sorter (S1-18). On the turn-on of the inlet sensor 314, a deflecting solenoid (SOL) designated by the bin designate signal is turned on (S1-19), whereby the paper sheet is steered to the bin 350 of interest.

When the paper sheet is driven out onto the designated bin 350 (S1-20), a paper discharge signal is sent to the copier (S1-21) to report that the paper sheet has been surely discharged onto the bin 350. In response, the copier determines the next destination, the destination after jam recovery, etc. When a suitable period of time necessary for the paper sheet to be settled on the bin 350 (e.g. 300 milliseconds; step 1-22), the size shift motor 515, Fig. 17, is turned on to shift the jogger shaft 502 (S1-23) so as to position the paper sheet in the direction (lateral) perpendicular to the paper discharge direction. It is to be noted that the shaft 502 is shifted at a particular timing which is based on the discharge of the trailing edge of a copy sheet as sensed by the sensors 322 and 324 (S1-24).

It sometimes occurs that after the positioning operation a paper sheet fails to reach the end of the bin 350 or to the bin fence 450 due to curl, scratch or fold on the paper surface and/or substantial static electricity. In the light of this, the positioning solenoid 342 is turned on (S1-25) simultaneously

with the shift of the jogger shaft 502. As a result, the positioning roller 333 in rotation is brought into contact with the upper surface of the paper sheet to press the curl and urge it to the end portion (predetermined period of time = 200 milliseconds; S1-26). The positioning roller 333 is associated with all of the bins 350, and all the positioning rollers 333 are lowered at the same time by the positioning SOL 342. Thereafter, the positioning SOL 342 is deenergized (S1-27).

The above sequence is executed every time a paper sheet is discharged so as to position it (sorting or stacking) (S1-28). As the sorting or stacking operation ends, the sorter motor 313 is turned off (S1-29) and stapling is effected. In response to a staple start signal (S1-30), the stapler unit 700 is actuated (S1-31) to staple a stack of paper sheets. On completion of the stapling operation (S1-32), the stapler device 700 and jogger shaft 502 are returned to their home positions (S1-33).

The paper positioning operation and the movement of the jogger shaft 502 will be described with reference to Figs. 69 and 70. The jogger shaft 502 is held in a halt beforehand in a particular position matching the size signal (in the embodiment, a position about 10 millimeters spaced apart from the edge of a paper sheet which will be discharged), as stated earlier. Any suitable position may be selected so long as it prevents the shaft 502 from catching a paper sheet P and thereby causing it to jam or fold itself (Fig. 70 (a)). On the lapse of about 300 milliseconds after the discharge of a paper sheet onto the bin 350, the jogging operation occurs.

First, a phase signal in the form of pulses the number of which is associated with a displacement of 25 millimeters is fed from the I/O port 803 to the constant voltage driver 811. As a result, the size shift motor (stepping motor) 515 is rotated counterclockwise to move the jogger shaft 502 by about 25 millimeters toward the paper sheet (S2-1; Fig. 70 (b)). Th moving speed of the shaft 502 may be, but not limited to, about 500 pps. The gist is that the moving speed does not crease, scratch or fold the paper sheet P. Consequently, the paper she t on the bin 350 is shifted by an extra amount of about 5 millimeters and thereby urged against the bin fence 450. If desired, an extra amount of feed other than 5 millimeters may be selected if it is capable of coping with irregular lengths of paper sheets P and impl menting sur positioning.

After urging the paper sheet P against the bin fence 450, the shaft 502 is once brought to a halt (in the embodiment 50 milliseconds) ; S2-2). This step is not essential, however, since it is simply to switch the rotating direction of the size shift motor 515. Thereafter, the motor 515 is rotated clockwise by the number of pulses associated with a displacement of 5 millimeters, so that the shaft 502 may move 5 millimeters away from the paper sheet (S2-3) ; Fig. 70 (c)). At this time, the moving speed of the shaft 502 is selected to be about 300 pps. Nevertheless, any other speed may be selected so long as it is lower than the speed at which the paper sheet P springs back after the extra amount of feed, i. e., the position of the paper sheet P is not disturbed due to elasticity. Stopped after the 5 millimeters return, the shaft 502 serves as a bin fence at the opposite side to the bin fence 450. This, coupled with the fact that the shaft 502 remains in a halt for 50 milliseconds (S2-4), insures the position of the paper sheet P. Subsequently, the shaft 502 is returned to the initial position to prepare for the next paper sheet (S2-5; Fig. 70 (d)) and stopped there (S2-6). At this time, the moving speed of the shaft 502 need only be the speed at which the shaft 502 will be in time for the discharge of the next paper sheet. In the case that complete positioning is not attainable (paper sheets with substantial curl), the entire or a part of the jogging operation may be ffect d a plurality of times with a single paper sheet.

Assume that more than a predetermined number of paper sheets which can be stacked on the bin 350 (in the embodiment, thirty paper sheets) are driven out onto the bin 350. Then, stapling the discharged paper sheets is inhibited, and the shaft 502 is retracted to the home position without performing the jogging movement, as will be described with reference to Fig. 71.

The number of paper sheets stacked on the bin 350 is detected by counting paper sheets (S3-2) which are sequentially discharged onto the first bin (S3-1). When it is decided that the number of paper sheets on the first bin has exceeded the number which can be stapled (S3-3), the shaft's jogging operation and the roller's positioning operation are interrupted (S3-4). Then, the shaft 502 is retracted to the home position (S3-5). Afterwards, the positioning operation is not performed with paper sheets which may be discharged. Stapling the paper sheets already stacked on the bin 350 is also inhibited (S3-6).

The stapling operation will be described with reference to Figs. 72A to 72I. When paper sheets exist on the bins 350 after the sorting operation, the copier sends a staple start signal to the sorter. On receiving the staple start signal, the control system resets a sequence counter to 0 (S4-1). The stapler device 700 located at the home position is moved to the first bin 350 whose paper stack is to be stapled (S4-2). After the stapler unit 700 has reached the first bin 350, the program is

executed on the basis of the value of a staple sequence counter shown in Fig. 72A. On the arrival of the stapler device 700 at the first bin, the staple sequence counter is set from 0 to 1 (S4-3).

When the value of the staple sequence counter is 1 (S4-4), the chuck motor (stepping motor) 646 is turned on (S4-5, Fig. 72B) to thereby move the chuck section 620, Fig. 53, forward. In this instance, the displacement is determined by the number of pulses (S4-6). By this displacement, chuck 620 is moved from the home position to the position where it can chuck the paper stack. When the chuck section 620 is fully advanced (S4-7), the staple sequence counter is set to 2 (S4-8).

When the staple sequence counter is 2, the chuck SOL 626 is turned on (S4-9, Fig. 72C) to chuck the paper sheet. Then, the staple sequence counter is set to 3 (S4-10).

When the staple sequence counter is 3, a timer is started (S4-11, Fig. 72D) to hold the state for 0.2 second. On the lapse of 0.2 second (S4-12), the timer is stopped (S4-13) and the staple sequence counter is set to 4 (S4-14). This is successful in absorbing the response time of the chuck SOL 626 and insuring the chuck.

When the staple sequence counter is 4, the chuck motor 646 is turned on (S4-15, Fig. 72E) to return the chuck 620 toward the home position. Then, the chuck home sensor 650 responsive to the arrival of the chuck section 620 to the home position is

turned on (S4-16), the chuck section 620 is brought to a stop at the home position, and the chuck motor 646 is turned off (S4-117). Subsequently, the staple sequence counter is set to 5 (S4-18). At this instant, the chuck motor 646 is driven in a nearly constant acceleration motion. In the illustrative embodiment, the speed is increased from from 600 pps to 2000 pps in a slow-up mode.

When the staple sequence counter is 5, the output of the paper sensor 675, Fig. 56, is checked (S4-19, Fig. 72F). If the answer of the step S4-19 is positive (YES), the staple motor is turned on (S4-20) to staple the paper stack. Whether or not the stapling action has completed is determined by referencing the output of the staple home sensor (S4-21). If it has completed, the stapling operation is ended (S4-22). Then, the staple sequence counter is set to 6. If the answer of the step S4-19 is negative (NO), the stapling operation is not performed and, instead, the chuck SOL 626 is turned off (S4-24). Thereafter, the sequence counter is set to 8 (S4-25).

When the staple sequence counter is 6 (S4-26), the chuck motor 646 is again moved forward (S4-27, Fig. 72G) to return the stapled paper stack to the bin 350. After the chuck motor 646 has been rotated by a predetermined number of pulses (S4-28), it is stopped (S4-29) and the chuck SOL 626 is turned off (S4-30) to open the chuck arms 622 and 624. Thereupon, the timer is started (S4-31) and, on the lapse of th response

time of 0.2 second of the chuck SOL 626 (S4-32), it is stopped (S4-33). Subsequently, the staple sequence counter is set to 7 (S4-34).

When the staple sequence counter is 7, the chuck 620 is shifted to a position where it can be lowered to the next bin 350 without contacting the bin 350 with the stapled paper stack. Such a procedure reduces the interval per bin between the chucking and the end of stapling and thereby increases the system productivity. Specifically, the chuck motor 646 is started (S4-35), moved backward by the predetermined number of pulses (S4-36), and then stopped (S4-37). Subsequently, the staple sequence counter is set to 8 (S4-38).

When the staple sequence counter is 8, meaning that the stapling operation has completed, the elevation motor 720 is turned on (S4-39, Fig. 73I) to elevate the stapler unit 700. As soon as the elevation home sensor 729 turns on (S4-40), the elevation motor 720 is deenergized (S4-41) and the staple sequence counter is reset to 0 (S4-42).

The sequence of steps associated with the values 0 to 8 of the staple sequence counter is executed until the stapling operation completes. Subsequently, the size shift motor 515 is turned on. When the size home sensor 501 turns on, the motor 515 is turned on. It is to be noted that the return of the stapler unit 700 to the hom position and the movement of the jogger shaft 502 may be effected at the same time or in th opposite

order to the illustrative embodiment. Regarding the jogger shaft 502, it may be moved after all the paper stacks on the bins 350 have been removed, i. e., when the bin sensors 321 and 323 have turned off.

The slow-up and slow-down funtions associated with the up-down movement will be described. This functions are such that the moving speed is sequentially increased at the beginning of an up-down movement, and maintained constant on reaching a predetermined value, and that the moving speed is sequentially decreased at the end of an up-down movement before a bin of interest is reached, maintained constant on reaching a predetermined value, and then decreased to zero at the bin of interest. With such functions, it is possible to promote effective use of the torque of the elevation motor 720 and to insure accurate stops.

Fig. 73 is a flochart demonstrating the slow-up and slow-down procedures. As shown, in a subroutine which is called every 1 millisecond, if the slow-up operation has not been completed (S5-2) after the turn-on of the elevation motor 720 (S5-1), a slow-up counter is incremented by 1 every time th subroutine is called (S5-3). Among a group of speed data stored in the ROM 801 and set such that the speed sequentially increases, speed data is read out on the basis of the value of th slow-up counter (S5-4) and set in the CTC 804 (S 5-5). In respons , the CTC 804 generates frequencies based on the speed

data and feeds them to the phase signal generator 813, Fig. 67. The phase signal generator 813 delivers a phase signal to the constant current driver 812 with the result that the elevation motor 720 is rotated at speeds associated with the speed data.

When the slow-up counter reaches a predetermined value (S5-6), the slow-up sequence is ended (S5-7) so that the elevation motor 720 is rotated at a constant speed.

On the lapse of a predetermined period of time, a slow-down sequence begins (S5-8). A slow-down counter is incremented every time the subroutine is called (S5-9). Among a group of speed data loaded in the ROM 801 and set such that the speed sequentially decreases, speed data associated with the value of the slow-down counter is read out (S5-10) and set in the CTC 804 (S5-11). Then, the CTC 804 generates frequencies based on the speed data and delivers them to the phase signal generator 813. In response, the phase signal generator 813 feeds a phase current to the constant current driver 812 to drive the elevation motor 720 at speeds associated with the speed data.

When the slow-down counter reaches a predetemined value (S5-12), the slow-down sequence is ended (S5-13). Thereafter, the elevation motor 720 is rotated at a constant speed. As the stapler reaches a bin of interest, the slow-up and slow-down counters ar cleared (S5-14). The chuck motor 646 is also subjected to such a slow-down sequence.

Figs. 74 and 75 show another specific configuration of the paper pulling device 615 which is essentially similar to the configuration described with reference to Fig. 53 and successive figures, except for an extension 616. Specifically, the extension 616 of the paper pulling device is so located as to face the opening 701 of the stapler 701 for pressing a paper sheet. As shown in Fig. 75, the extension 616 is positioned at a slightly lower level than the top of the opening 701a of the stapler 701. The paper pulling device 615 with the extension 616, therefore, can surely guide a paper sheet from the opening 701a to the stapling position even if the paper sheet is noticeably curled and tends to lift itself beyond the top of the opening 701a.

In summary, the present invention achieves various unprecedented advantages as enumerated below.

(1) Chucks of a paper pulling device shift a paper stack by chucking the paper stack at two or more points of the latter and thereby frees the paper stack from moments otherwise acting on it to bring about skew. The paper stack can, therefore, be surely stapled at a predetermined stapling position while remaining in the neatly regulated position. This is practicable only with a plurality of chucks, i.e., without resorting to a bulky device otherwise required to guide a paper stack, cutting down the cost.

(2) A point of force acting on a low r rotatable lever is located b tween the fulcrum of rotation of an upper lev r and an

upper chuck, while an axis of rotation is provided between a portion of the lower lever that contacts the point of force and the lower chuck. In this configuration, the displacement of the lower chuck is smaller than that of the upper chuck so that the lower chuck is prevented from catching paper sheets. This insures chucking and, therefore, accurate stapling. All that is required is changing the position of the fulcrums of rotation of the levers, i. e., it is not necessary to change the gear teeth ratio or the leverage. This contributes a great deal to the reduction of cost.

(3) The paper pulling device is driven by a stepping motor capable of accelerating and decelerating with substantially constant acceleration. This promotes easy control over the acceleration and deceleration of the device. A paper stack is shifted in substantially the same acceleration condition and, therefore, stapled without the neatly stacked position being disturbed. Of course, the simple control over acceleration and deceleration leads to the cut-down of cost.

(4) A stapler has an opening for accommodating a paper stack while the paper pulling device has a member for guiding the leading edge of a paper stack to the opening. This eliminates the need for means otherwise provided on the individual bins for pressing paper sheets, allowing a paper stack to be positioned and stapled at low cost.

CLAIMS

1. A finisher for finishing paper sheets, comprising:

a sorter comprising a plurality of bins arranged one above another for receiving paper sheets to be transported one after another thereto;

a stapler for stapling a stack of the paper sheets discharged onto each of said bins, each bin comprising

a paper positioning device for positioning paper sheets on said bin;

said paper positioning device comprising a fence extending along one side edge of said bin, and a positioning member reciprocatingly movable from a standby position towards said fence and towards said standby position away from said fence, said positioning member being adapted to stop in at least a first stop position, a second stop position and a third stop position to position a stack of paper sheets.

2. A finisher according to claim 1, wherein the distance between said first stop position and said fence is greater than a size of the paper sheets to be discharged onto said bin, the distance between said second stop position and said fence is smaller than the size of said paper sheets, and the distance between said third stop position and said fence is equal to the size of said paper sheets.

3. A finisher according to claim 1 or 2, further

comprising drive means for driving said positioning member, and a sensor for sensing the size of the paper sheets and a sensor for sensing the size of the paper sheets discharged onto said bin.

4. A finisher according to claim 3, further comprising control means for controlling said drive means such that said positioning member starts moving from said standby position and, after having stopped at said first to third positions, returns to said standby position at a variable speed.

5. A finisher according to any preceding claim wherein an elongate slot is formed through said bin adjacent to a side edge opposite the bin fence the slot extending towards said fence, said positioning member comprising a jogger shaft extending substantially vertically throughout slots which are formed through said individual bins.

6. A finisher according to claim 5, wherein one or more high friction members are provided on a surface of said jogger shaft.

7. A finisher for finishing paper sheets, comprising:

a tray for stacking paper sheets to be transported thereto;

a fence provided on said tray and extending along one side edge of said tray; and

a positioning member reciprocatingly movable from a

standby position towards said fence and towards said standby position away from said fence and adapted to stop in at least a first stop position, a second stop position and a third stop position for positioning the paper sheets.

8. A finisher according to claim 7, wherein on said tray the distance between said first stop position and said fence is greater than a size of the paper sheets discharged onto said tray, the distance between said second stop position and said fence is smaller than the size of said paper sheets, and the distance between said third stop position and said fence is equal to the size of said paper sheets.

9. A finisher according to claim 7 or 8 further comprising drive means for driving said positioning member, and a sensor for sensing the size of the paper sheets discharged onto said bin.

10. A finisher according to claim 9 further comprising control means for controlling said drive means such that said positioning member starts moving from said standby position and, after having stopped at said first to third positions, returns to said standby position at a variable speed.

11. A finisher constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

12. An imaging apparatus comprising a finisher according to any one of the preceding claims.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9319634.3
Relevant Technical Fields (i) UK Cl (Ed.L) B8R (RAD10,RAD5,RAG3,RAG5, RARC,RAR1,RAR2,RSC,RS7) (ii) Int Cl (Ed.5) B65H 9/10, 31/34, 31/38	Search Examiner E W BANNISTER Date of completion of Search 4 NOVEMBER 1993
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1-12

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding docum nt.

Category	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

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